FOOD MANUFACTURE

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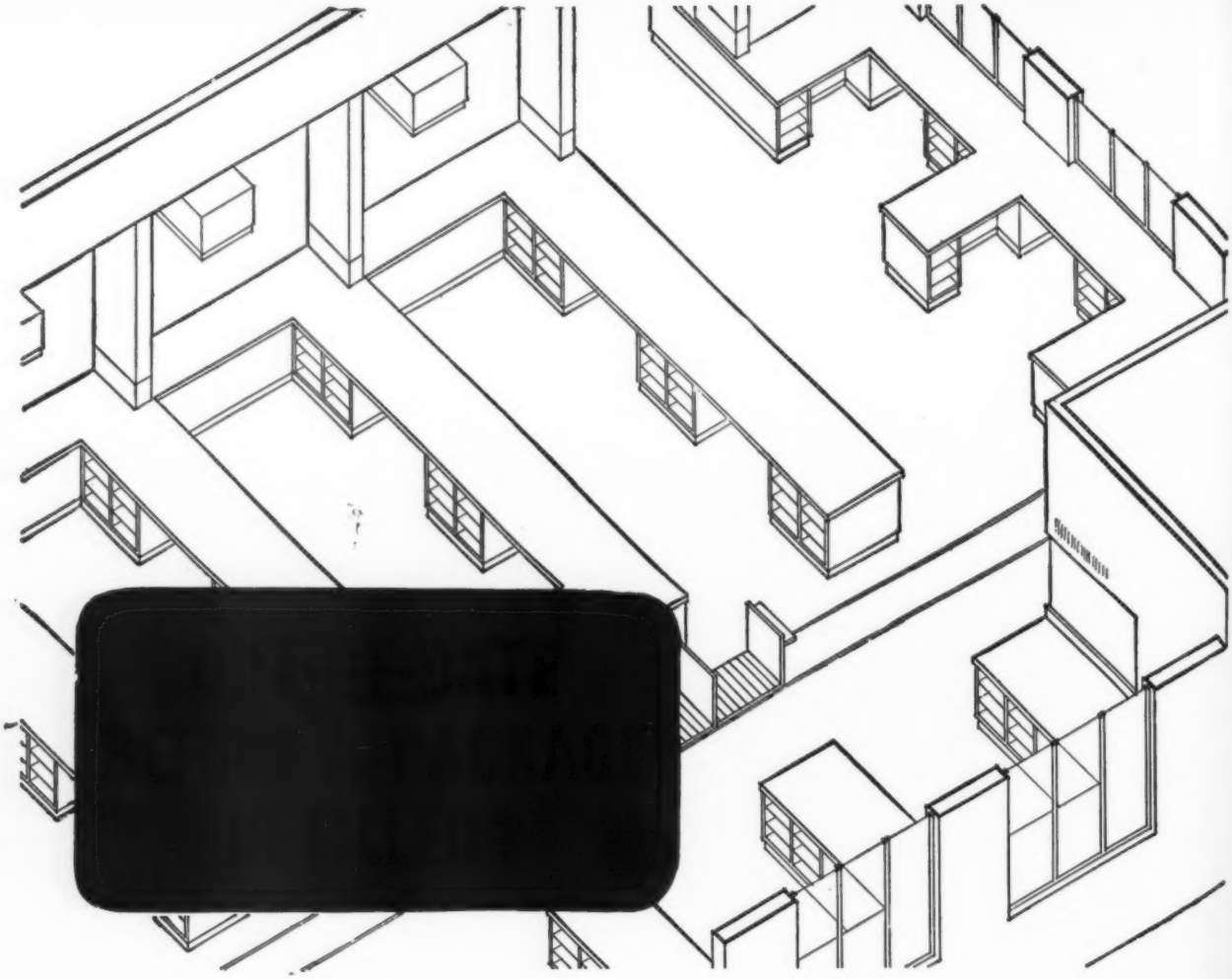

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C.2328

FOOD MANUFACTURE

Vol. XXVII. No. 11 · Published Monthly · November 1, 1952

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FOOD MANUFACTURE

Vol. XXVII, No. 11 November 1, 1952

Tracking down Food Infections

ONE of the difficulties inherent in food poisoning epidemics is the tracing of the original source, or sources, of infection, although in many cases this is done successfully.

An additional weapon in the hands of the scientists was described by Brigadier J. S. K. Boyd in the Jenner Memorial Lecture. It has long been possible to confirm the presence of a specific infection in people suffering from certain diseases, and also in "carriers," but not until recently to distinguish between the strains of the same bacteriological species. That the importance of the possibility of differentiation is very great is evident when it is realised that 30 different strains of haemolytic streptococci have been classified by ascertaining the antigenic differences between them. It is, however, impossible to subdivide a number of species by methods hitherto applied. The typhoid bacillus is an example. It is subject to no variations in either cultural characters or antigenic constitution which enable one strain to be distinguished from another. It was for this species that phage-typing, the subject of the Jenner Memorial Lecture, was brought into use. Susceptibility to lysis by different phages now serves to distinguish no less than 36 types of typhoid bacillus.

Boyd describes some remarkable cases of the application of this method, one of which concerned the tracing of scattered cases of typhoid fever in the Home Counties to a single carrier, a farmer in Wiltshire, whose intermittently contaminated milk, which was mixed with that of other farms, went to households in five different counties. Without type identification it would have been difficult even to suspect and impossible to prove that this obscure source was responsible for so many cases of typhoid fever occurring over a period of nearly two years.

What can be done with typhoid bacilli is now also possible, although on a more restricted scale, with paratyphoid fever and at least two members of the food poisoning group.

Staphylococci have been concerned with "prepared" or unheated foods such as custard-filled pastries, milk, cheese, salads, ice cream, meat products, and sandwiches, and a great deal of work has been expended on methods for the identification of food poisoning types. It is possible for a single infected person or carrier to contaminate food served to large numbers of people, and several instances of the identification of such a source and its verification by typing have occurred during the past few years. As the leader writer in the *B.M.J.* (Sept. 27, 1952) points out, there need be very few unsolved problems in the epidemiology of these infections in the future.

The persistence of the appearance of food poisoning has occupied the attention of those concerned with its causes and prevention, and the additional help afforded by phage-typing will be valuable.

World Food

Is it morally right to develop so many means of curing and stemming disease when the resultant increases in population must bring food scarcity and famine in the end? This forthright question was put by Prof. A. V. Hill in his Presidential Address at this year's meeting of the British Association on "The Ethical Dilemma of Science." Obviously the problem not only concerns food; additional pressure will be placed upon all resources, but as time goes on, the scarcity of food will be the first to make itself felt.

The solution to the dilemma, if there be one, is to ensure that all possible steps are taken to increase world food production. Clearly the President of the British Association doubts whether non-scientists—politicians, business men, administrators, and so on—are prepared to make the attempt to implement this. However, the ethical position of science and scientists would be above suspicion if all those with authoritative knowledge about food production constantly presented their views and pressed for action.

An excellent example of this has been the series of Third Programme B.B.C. talks on "Research for Plenty." It seems a pity that these surveys of different aspects of scientific food production were not repeated on other wavelengths.

In his talk, "All Flesh is Grass," Dr. Norman Wright brilliantly scotched the thesis that world diet must become vegetarian if the available soils are to produce enough nutrition. The gross weight of the world's livestock may be twice that of the human race, domesticated animals may in many parts of the world eat five or 10 times as much food as humans; but they grow much faster, produce weight at a

much greater rate than humans, yet at the same time a proportion of this growth—of which so much in one way or another is edible—is based upon grass, a form of vegetation that mankind does not eat.

So long as meat and dairy produce is substantially based upon foods that humans themselves do not eat, it is not correct to suppose that world diet would be safer or more generally adequate were it wholly vegetarian. The higher standard of eating associated with Western civilisation because Western races are meat-minded is not to be dismissed as a luxury. It is a proper part of food production economy.

Degrees in Nutrition

FOR the first time in Britain the subject of nutrition has been elevated to university degree status. From 1953 London University will confer a B.Sc. (Nutrition) degree, though it will not be until 1956 that the first students who have completed the three-years' course at King's College of Household and Social Science will receive it.

The first year's studies will provide a fundamental grounding in biology, physics, chemistry, and social subjects. The second and third years will be devoted to chemistry, physiology, and to nutrition itself. Food production, food processing, diet planning, and hygiene will be included in the course.

This innovation by London University may do more to stimulate food science studies than all the reports and conferences on technological education. At least it raises the standing and purpose of training facilities that the country already possesses.

Combating Rice Shortage in the East

DURING the last decade, there have been increasing signs of activity on the part of scientists throughout the world to overcome the universal shortage of staple foods. As this deficiency increases, the necessity for such research grows more intense. It is not only the actual production of food which has had to be considered, but also the solution of plant and animal pest problems.

Probably the organisation which has done most in this sphere is FAO, whose more recent activities have included the Wheat Breeding Conference at Istanbul, when experts met to discuss the improvement of wheat production; the formation of a Working Party on Mediterranean pasture and fodder development; the provision of agricultural and advisory services for the farmer; and the stimulation of hybrid maize experiments in Europe which have now reached the stage of providing certain European countries with considerable quantities of American hybrids.

Much research work has lately been conducted in an effort to ease the serious shortage of rice in those Eastern countries where it forms the major part of the peoples' diet, an International Rice Commission having been established in 1949 by FAO, with a membership of 17 nations. It is not only the problems of rice production with which they have to contend, but also the shortage of soil specialists to instruct the rice producers in Asiatic countries, and the lack of suitable fertilisers and of effective methods for storage. Working Parties on rice breeding and on fertilisers were consequently set up, the former to study the production of hardier hybrid strains having larger yields and greater resistance to pests and diseases, and the latter the counteraction of the shortage of nitrogenous fertilisers by the use of leguminous and green manure crops. As well as establishing an international training centre for the instruction of soil specialists, FAO are also investigating more suitable methods for the storage of rice.

It is difficult for countries where rice forms such a very little part of the staple diet to realise the gravity of the situation. Partly owing to the bad harvest in India and decreased production in China, under five million tons of rice enter the world market each year. This figure should be nearer nine million tons; before the war it was eight million, and since then there has been a 10 per cent. increase in the oriental population. The deficiency has been met to some extent by imports of Western wheat, although wheat is not accepted as a complete substitute by the rice-eating peoples.

That the difficulties of tackling this urgent problem are more acute now than they were when the Commission was formed is shown by reports from Ceylon, which state that in addition to the amount of rice per head being reduced from the accustomed 14 oz. a day to 5·7 oz. a day, its price has risen to nearly £20 a ton above that of wheat, and the discrepancy between supply and demand is more serious now than in any one year since the war.

A Sugar Centenary

THE use of an air-blast for oxidising impurities in molten iron was first put into practice by the American inventor Kelly exactly 100 years ago, but the year 1852 also proved to be one of fruitful endeavour for Bessemer. To offset this slight anticipation of the well-known Bessemer process, credit should also be given to the Englishman for improving the sugar industry. It was in that year that Bessemer was granted a patent for the use of sulphur dioxide in the sulphitation of sugar liquors, an agent serving the double purpose of neutralising excess alkalinity after liming and of bleaching the juice. In France there had been first the sulphuric acid method in defecation, the pioneer Achard having also used this agent at Kunern. Next came the application of sulphurous acid also in France; but Bessemer gets the credit for gaseous sulphur dioxide as an anticipation of Sieveir's process of 1857.

Bessemer had too many irons in the fire to succeed on an appreciable scale in sugar manufacture; nevertheless, his contribution to cane sugar extraction must also be remembered. In days when he had never seen a sugar cane, he had specimens sent from Madeira, the ends being sealed with pitch so that he could experiment on improving the low extraction figure of 45 per cent. By noting how the older form of roller-mill flattened long canes and the knots or partitions in them, which caused the retention of much juice in closed-up cells in addition to that re-absorbed when the flattened cane expanded again, Bessemer saw how to improve things. He had the canes cut into six-inch lengths; then he introduced a much lighter roller-mill. He demonstrated his method right up to crystallised sugar from juice—the first of its kind ever made in London directly from cane.

Determination of Creatinine

THE determination of creatinine is of importance in the evaluation of meat extracts, as well as for biological fluids. With the Jaffé reaction there has been a tendency for a lack of concordance in results obtained by different analysts. A recent note by R. J. Garner (*Nature*, Sept. 13, 1952) is therefore of interest. As the author says, the method is recognised as being non-specific and must be applied with caution unless there is a large excess of creatinine present over interfering substances. The specificity of the method was greatly improved by Miller and Dubos (*J. Biol. Chem.*, **121**, 457, 1937).

Peters (*J. Biol. Chem.*, **146**, 179, 1942) has pointed out that a significant deviation from Beer's law becomes apparent at concentrations of creatinine greater than 5 mgm. per cent. This may be due to the bicolorimetric nature of the determination, the orange-red colour being a mixture of the red of the coloured creatinine complex and the yellow of unchanged picric acid. So far as is known, it has not been made clear that anomalies may also occur at low concentrations of creatinine.

It has been found that if the absorption spectrum of the creatinine complex (against a picric acid compensator) is plotted at different concentrations of creatinine, not only does $\lambda_{max.}$ vary, but so also does E (1 per cent., 1 cm.).

Most clinical methods recommend that the colour produced in this reaction should be read using a 520 mμ filter. An explicit reason for this can now be given, for the absorption curves become closely convergent at a wavelength of about 515 mμ.

The findings indicate that the reaction postulated by Greenwald (*J. Amer. Chem. Soc.*, **47**, 1443, 1925), in which one molecule of picric acid is said to react with one molecule of creatinine to produce a tautomeric (enolic) form of creatinine picrate, cannot be as simple as considered hitherto.

Legislative Weaknesses

A SCATHING condemnation of the present limitation of powers to control unsatisfactory production of sweetmeats is contained in the annual report of Ayrshire's Sanitary Inspector. When a scrap merchant began production of toffee apples in a most unsavoury house in a village, the inspector found himself blocked by existing regulations. An appeal was made to the Ministry of Food to stop sugar supplies, because it was evident that continued production was against the common weal.

The ice lollie trade also came in for some criticism. The county had the co-operation of the Department of Health for Scotland in visiting 265 traders in one area alone. Among the defects was the use of dirty bowls for mixing the liquids and of rough unsuitable sticks for handles.

Great emphasis has been placed in this report on the need for much speedier and more efficient powers to allow handling of cases where food production is involved and where legislative weaknesses are at present apparent.

Disease of Cloves

SPECIAL mention is made of the work of the clove research team in the Annual Report of the East African Agriculture and Forestry Research Organisation, who have been investigating the disease problem which has been worrying clove growers in Zanzibar—the largest producer of cloves in the world.

Two years ago there appeared in *World Crops* ("The Clove Industry of Zanzibar Protectorate," **2**, 143 and 198) two articles by Mr. R. O. Williams, who reviewed the clove industry in Zanzibar and discussed the disease position. There are two major maladies which attack the clove tree in Zanzibar. One known as "die-back" reduces yields but rarely is fatal; the other, known as "sudden death," causes the death of fully grown trees with dramatic and catastrophic suddenness, usually with little or no previous indication that anything is amiss.

Many plant pathologists and other specialists attempted to clear up the mystery of this latter disease but without success, the verdict of each succeeding specialist being that it could not be attributed to the group of causative agencies in which he specialised. As a result there arose, it might almost be said by default, a sort of conviction that it must be caused by a virus. This, too, proved disappointing as a hypothesis, since despite efforts to transmit the virus by all the techniques known to the virologist, only negative results were obtained.

Obviously it was time to think again and this the EAFFRO team, under the direction of Dr. F. J. Nutman, proceeded to do. After long researches they eventually succeeded in demonstrating that despite

the claims to the contrary of earlier authorities, there were indications that the disease might be caused by a fungus pathogen which has since been identified as a species of Valsa. This is invariably associated with "sudden death."

The behaviour of this fungus after the death of infected trees, and particularly the appearance of fructifications on the trunk, is in accord with the known manner of spread of the malady and suggests possible methods of arresting its spread. The matter is still under investigation and fuller information is promised in due course.

Meantime the other malady of clove trees has also been shown to be caused by a fungoid pathogen—a species of *Cryptosporella*—and measures have been demonstrated which, if properly put into practice, can arrest the spread of the disease. Moreover, it has also been shown that this same fungus can also cause the deaths of young clove trees in a manner closely resembling "sudden death."

It would therefore seem that after an interval of very nearly 30 years' work this mysterious complex of diseases may at long last be in a fair way to being cleared up.

The Role of Fish as Food

AMONG the ways in which food supplies could be increased fish production is one in which the possibilities for expansion are considerable. Fish production does not appear to have the same technical limitations in potentialities as many agricultural products. Many fish resources are still unexploited, and more could be created through fish culture work.

According to a report prepared by the FAO Fishery Division, for the 19th meeting of the Committee on Commodity Problems, the total gross weight of fish from the world's lake, river, pond, and sea fisheries, together with all catches of molluscs and crustaceans, has been estimated at some 25 million metric tons in 1949 or roughly 10 kg. per head annually.* This catch contained some 2 million tons of protein and possibly 600,000 tons of fat and was equivalent to a *per caput* supply of 850 grams per year (2·3 grams per day) of protein and 250 grams per year of fats. The daily calorie value of all fisheries products has been computed at some 15 per head.

This valuable supply of protein of a high biological value, as well as of fats and other nutrients, is not used directly for human food in its entirety; about 10 per cent. is used for oil and meal manufacturing and other non-food purposes. Also, a considerable, although not accurately known quantity, is lost in cleaning and processing. It remains true, however, that fisheries make a considerable contribution to the world supply of food, and to the supply of animal protein in particular amounting to some 10 per cent. of the total.

During the Sixth Session of the FAO Conference held in Rome in 1951, experts indicated that fisheries resources were such that total landings might be doubled without risk to world fish resources. There is no doubt about the need for such an increase, and if it is to be achieved, various technical and economic problems must be tackled, which will take some time. The problem is threefold: to reduce waste, to improve quality, and to increase production. Success demands a simultaneous attack on a broad front.

* The whaling industries, which account for some 2 million tons fresh weight, are not dealt with in the report.

Tastes and Exhalations

EVERY now and again a new wonder substance bursts upon us. A little time ago (as we reported) there was a minor explosion in the way of the "wonder food" blackstrap molasses, which was claimed to cure such irritating things as skin diseases, ulcers, and growths in the bowels.

More elegant in its connotations (in a manner of speaking) is chlorophyll, with whose attributes the world is being acquainted by all the customary advertising devices.

Originally known as a veritable wonder substance for its job in the matter of photosynthesis, it has also been used as a colouring matter for toilet soaps, a medical "restorative," an air and body deodorant, and an ingredient of tooth pastes.

More recently it has been proposed as an eliminator of the fishy taste of whalemeat which has been blamed for its lack of popularity; it is hoped that by removing it the public may be induced to take advantage of a valuable additional source of protein. We are informed that Ministry of Food scientists are conducting tests to prove its efficacy or otherwise for the purpose; at the time of this writing no definite conclusion has been reached.

Next we come to what have been called the "social uses" of chlorophyll. Perhaps these may be best explained by a quotation from a recent release that has reached our desk. "Landlords of smart pubs and hostelries in the West End are both using and giving away little tablets containing ultra violet ray activated chlorophyll."

"We display them on our snack bar among the cheese, pickles, and onions," one barmaid said. "They take away all smell of both food and drink, and our customers no longer hesitate to drop in for a drink before attending business conferences."

It is a refreshing conception—potation without exhalation. It seems that those partial to a drop o' beer will now be able to say with Ben Jonson:

> Nor shall our cups make any guilty men;
> But at our parting we will be, as when
> We innocently met.

Seventy-five Years of Preserving

One of Holland's oldest food preserving concerns is that of Tieleman and Dros at Leyden where, for the last 75 years, a wide range of products, such as meat, fruit, vegetables, jam, pickles, and soups, has been canned.

FOUNDED at Leyden in 1877 under the management of Casparus Cornelis Tieleman, Cornelis Dros, and Dirk Cornelis Dros, the company of Tieleman and Dros, whose present-day management is still in the hands of direct descendants of these pioneers, is one of the oldest and most representative factories of the Dutch canning industry.

The choice of Leyden for the construction of the factory was not a haphazard one as the town is situated in the centre of the Dutch vegetable and cattle growing area. Thus the transport of the raw materials to the factory is a rapid procedure, and ensures that the produce arrives at the factory in the best possible condition.

All raw meat received from the slaughterhouses is carefully examined and checked for weight before being passed for processing.

Modernisation of Plant

In recent years, the company has invested large sums of money in the renewal and modernisation of machinery and plant, resulting in the attainment of a high degree of mechanisation. Despite this, however, the company still employs, in the busy season, between 700 and 800 men and women.

From the wide range of products manufactured, the canning of peas, fruit, and meat products has been selected for description.

The company has its own vining installation which can deal with some 35 acres a day, yielding approximately 75,000 lb. of peas. After passing through a shaker for the separation of pod parts and other extraneous matter, the peas are packed in boxes, stacked on lorries, and transported to the plant about 15 miles away.

The boning and the removal of skins and sinews are carried out by hand.

On arrival at the factory, the peas are subjected to a washing process, graded in six sizes, and cooked for two to five minutes according to quality and size. The cooking operation is followed by a final washing during which the loosened skins are removed from the peas.

Before they are filled into cans, the peas are transported by slow moving conveyors, any faulty ones being removed at this stage. After exhausting and sealing, the cans are sterilised for 50 minutes in vertical retorts at a temperature of 110°C. and cooled.

The output from the pea canning line is 150 cans a minute. The outputs in respect of other vegetable products are 5,000 lb. of beans an hour, and 25,000 cans of spinach per shift of 8½ hours.

One of the battery of four filling machines used in the luncheon meat line.

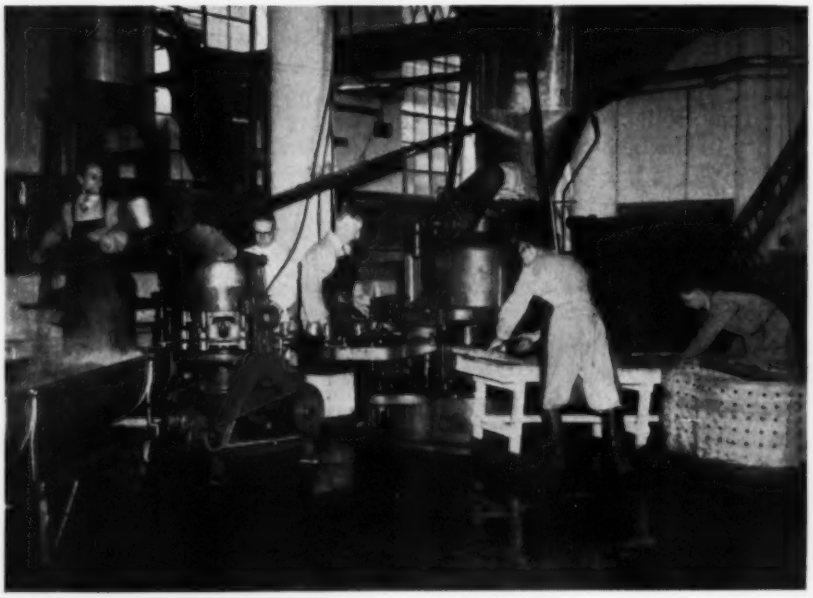
The Meat Department

Government regulations in Holland lay down that all slaughtering is to be carried out in municipal slaughterhouses; thus there is no slaughtering accommodation at the company's factory. All raw meat received from the slaughterhouses is carefully examined and checked for weight before being passed for processing.

Luncheon meat is one of the packs which is made in large quantities for the export market, particularly for Great Britain.

For the production of this commodity, all the boning and the removal of skins and sinews are carried out by hand. In this way, approximately 10 tons of raw meat a day are handled. After these preliminary operations, the meat undergoes three further preparing processes. Cutting, the incorporation of other ingredients, and the mixing of the several different types of meat which compose the product, are carried out by three separate machines at the rate of 5 tons per hour.

A battery of four filling machines is used for the luncheon meat line. The filled cans are then seamed at 125 cans per minute, and sterilised for two hours, after which they undergo the usual operations of washing, cooling, and labelling.



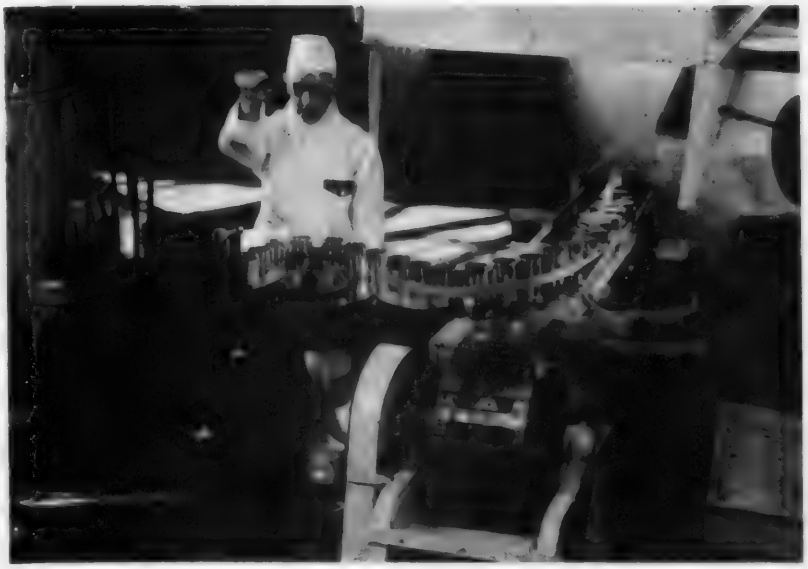
Part of the filling and seaming department.

Fruit Canning

The most suitable types of soft fruit, such as strawberries and raspberries, are grown in the neighbourhood of Breda, in one of the southern provinces of the Netherlands. To avoid damage caused by long distance transport and in order to pack the fruits in as fresh a condition as possible, they are processed on the spot.

All the fruits are hand packed in lacquered cans and sterilising times are kept as short as possible to avoid the breaking up of the fruit—approximately 30 minutes at 80°C. All fruits are packed in a heavy syrup with a sugar content of 25 per cent.

After boning, cutting to the required weight, and pressing, the hams are filled into cans which are hand soldered following seaming.



Above: **After a final inspection, the cans are sealed.** *Below:* **Packed products emerge by conveyor for transport by barge.**

Canned Ham

Following the preliminary operations of cutting and the removal of superfluous fat, etc., the hams are cured for four days in brine of 12° Baumé. They are then washed, dried, and smoked for a period, according to taste, type, and size. On an average, the smoking operation occupies from four to five hours.

The hams are next boned, cut to the required weight, and pressed. They are then filled into cans which, after seaming, are soldered by hand. This operation is carried out with all the company's vacuum filled meat products. After seaming and extra soldering, the cans are exhausted at the rate of 60 per minute and finally cooked in open boilers for a period at 80°C.

Can-making Section

The company has been making its own cans since operations started in 1877. Today, its can-making plant has an annual capacity of 10 million cans. Most of these are produced in sizes A1, 2, and 2½ on the two fully automatic lines with a speed of 125 cans a minute per line. The plant is located on the third floor adjacent to the production department for vegetables, the cans moving directly to the automatic fillers.

The name Mill Brand, under which the company's products are marketed, is known throughout the world and has come to be recognised as a symbol of the high standard of efficiency and hygiene upheld by the company.

The sole distributors in Britain are L. I. Silber and Co.

Correspondence

To the Editor of
FOOD MANUFACTURE.

Growth Promoting Factors

DEAR SIR,—In referring to my work on the effect of a liver preparation on the growth of children, you quote the comment of the leader-writer in the *British Medical Journal*. This suggests that the effect may not necessarily be of advantage to the child.

While of course it is too early to be quite certain of the possible permanent effects of this dietary supplement, general nutritional experience suggests that they are much more likely to be beneficial than otherwise. It is reasonable to suppose that the results indicate that the children whose growth was promoted by the supplement were being given a nutritional component which was deficient in their ordinary diets. On this basis, one must expect that the making good of the deficiency can only be beneficial.

We know that the deficiency of any nutrient is likely to impair growth; if a child is receiving a diet deficient in protein or any vitamin, his growth is likely to be sub-optimal. Surely no one would maintain that, in such a case, it would not be desirable to make good the deficiency by giving additional supplies of the nutrient in question.

While it is true that we do not as yet know what are the nutritional factors in the liver which are concerned, it seems as logical to give such a preparation as it was to give cod liver oil to children having, or likely to have, rickets in the days before it was known that the active principle is vitamin D.

Yours faithfully,
JOHN YUDKIN.

Department of Physiology, King's College of Household and Social Science, University of London.

TO AUTHORS

FOOD MANUFACTURE is prepared to consider the publication of articles on the subjects covered. Books on food would also be considered.

The Chemistry and Physics of Macaroni Products

Part IV

J. A. Radley, M.Sc., F.R.I.C.

In this instalment, the author discusses the drying process, which is probably the most important of any single step in macaroni production, since poor drying will ruin the product however perfectly the other steps may be carried out.

PRACTICALLY no published work appeared on the drying process until the publication of Hoskins' paper in 1932,[46] which attempted a rational approach to the problem but contained no fundamental data on the basic problems.

Commercial procedure appears to be divided into three stages: a preliminary drying period, followed by re-moistening or sweating, or by slow drying followed by the final drying. The dough from the press is plastic and readily moulded or pulled out, but it loses this property during one stage of drying, and behaves more like a brittle material, such as glass, *i.e.* a material which is weakest in tension. In the initial stage macaroni is ductile, but after the removal of some moisture it is both ductile and elastic over a certain moisture content.

Object of the Drying Process

Semolina contains about 11 to 14 per cent. moisture; in the mixing process more water is added to give a dough of the correct consistency. After pressing and drying, the product may contain 10 to 13 per cent. moisture. If drying is too rapid numerous cracks will appear, while slow drying may result in souring or mould growth.

The main aim in the drying process is, therefore, to remove moisture from the surface of the product at the same rate as the moisture passes from the interior of the goods to the surface. If the moisture is removed more rapidly from the surface than it can be replaced by more from the interior, the surface becomes case-hardened and commences to shrink. This effect is invariably deliberately induced soon after extruding long goods in order to make them stronger to handle, after which they are sweated to soften the case-hardened region and to relieve the strains set up; it is then that the drying process proper is started.

Under the same conditions of humidity and rate of air circulation, macaroni or spaghetti is dried at a rate corresponding closely to the thickness of the strand and to the surface area exposed to the air. As macaroni contracts during drying, the outside layer must not be dried at a rate which will harden it, thus making it only slowly pervious to moisture, before the moisture of the inner mass is absorbed.

On applying a stress, *i.e.* slow bending of the material in the upper moisture range, it can still flow to relieve the stress, and in the lower moisture range it is brittle and can be flexed to some extent before it snaps. There appears to be no sharp dividing line in which the properties suddenly change from one kind to another, although it does appear that one-third of the water in the dough can be removed rapidly and still produce a satisfactory product. However, this rate of removal is not common with all types of long goods, and in all probability it depends upon the dimensions of the product.

The amount of water bound by the gluten and starch under varying conditions has been found by a number of workers to lie within the limits of 26 to 30 per cent. on a dry basis; it would appear that the lower value is the limit for moisture content where slowly applied stress can be relieved by the flow of the material within itself.

Preliminary Drying Operation

Commercially, about 25 lb. of water is added to 100 lb. of semolina of, say, 13 per cent. moisture content, giving a dough containing approximately 44 per cent. moisture (dry basis). Preliminary drying or fanning can, therefore, be carried out so that the moisture content at the end of some 20 to 60 minutes is approximately 30 per cent. but the product is now partly case-hardened and is soft but brittle. This drying stabilises the shape of the macaroni, prevents mould formation, and shortens the total time of drying.

At this point, there will be in the material a gradient of moisture content, *i.e.* the outside layer of macaroni will be drier than that in the interior. This will tend to step up strains in the material. It is, therefore, the usual practice to stop the actual drying process at this period to allow the moisture content to even out, thus relieving the strains while the material is still capable of a viscous flow. This is known as the sweating or re-moistening period.

After standing in still air in the drying chambers for one to two hours, to sweat the strands, they become plastic again. This process may be hastened by saturating the air in the sweating room with moisture at high temperatures. Moisture cannot evaporate from a wet surface if the air is already saturated, so that the goods lose no weight during this period.

Control of Drying Conditions

In the final drying, the moisture content of the long goods is gradually reduced to 11 to 12·5 per cent. moisture. It is during this period, the longest step in the process, that the most careful control of drying conditions is necessary. Some manufacturers introduce several sweating periods during this final drying process.

In drying, four fundamental factors have to be taken into consideration. They are:

(*a*) Relative humidity of the air around the goods.
(*b*) Temperature of air and goods.
(*c*) Rate of air circulation.
(*d*) Rate of diffusion of moisture in the product.

If (*a*) is low and (*b*), (*c*), and (*d*) are high, rapid drying of the product will take place. If the last three factors are lowered, the drying process is slowed down, a similar effect being obtained by raising (*a*). When (*a*) reaches 100 per cent., no drying will take place at all. The density of the product also appears to influence the rate of drying, but, so far, the relationship between the two has not been studied at all.

As the paste dries it contracts, and if this contraction takes place too rapidly the material sets before the internal structure can accommodate itself to relieve the stresses and strains set up in it by the contraction. Any later change in moisture content, *e.g.* storage in a drier or damper atmosphere, may lead to an aggravation of these strains at certain minute centres in the goods so that the strength of the material is no longer equal to the strain and it cracks at that point. Sometimes the product appears all right in the drying room, but when removed to a cooler room it begins splitting and crazing. Since a temperature change is involved it was thought that thermal strains might be responsible.

Thermal Expansion of Macaroni

Direct measurement of long rods of spaghetti at different temperatures shows that any expansions of the material owing to heat are so small as to require special means of measurement, but it was found that a 10 in. length of spaghetti, heated from 0°C. to 100°C., showed an increase in length of 0·05 in. This is extraordinarily small since it means a coefficient of linear thermal expansion per °C. of ·00005, *i.e.* approximately 50 parts per million. It would appear that this expansion is far too small to produce the large strains which will be shown below to be necessary to cause cracking of the macaroni.

Earle and Ceaglske[47] have worked on this problem and have modified Barker's equation for thermal stresses in long tubes of circular cross-section to compute the maximum tangential stress caused by the formation of a moisture gradient between the inner and outer surface of the tube. The maximum tangential stress owing to a temperature change of 20°F. without change in moisture can be shown to be approximately 19 p.s.i. This is negligible in comparison with the magnitude of the forces caused by internal strains, which are discussed below. They computed that the moisture gradient may vary from 1·5 to 2·5 per cent. without fracture.

Cracking can be brought about at room temperatures merely by altering the relative humidity of the air surrounding the sample, while keeping the temperature constant, so that moisture would appear to play an important part in crazing.

Moisture Shrinkage

On investigating the drying process, the author soon found that macaroni from a normal, dry atmosphere, when placed in a wet atmosphere, picks up water until it is in equilibrium with the surrounding atmosphere. A figure of 21·7 per cent. moisture content was obtained on macaroni conditioned in an atmosphere of 95 to 100 per cent. relative humidity, while at 5 per cent. RH the moisture content fell to 1·6 per cent.

During this process of taking up moisture, the macaroni can be seen to swell, and further work showed that, at any given relative humidity, the macaroni contains a definite amount of moisture. Approximate measurements of the swelling and shrinkage of 10 inch lengths showed that the coefficient of expansion or contraction owing to moisture gain or loss is roughly twice as great around 7 to 10 per cent. moisture content as in the 22 per cent. region. Even though the figures obtained are approximations only, they indicate that at the lower moisture content greater swelling or shrinkage accompanies the same increase or loss in percentage moisture than occurs in the region of high moisture content.

Drying from 10 per cent. to 7 per cent. moisture content gives a shrinkage of approximately 0·1 inch per 10 inch strip, while drying from 24 per cent. moisture content to 21 per cent. gave a value a little more than half this. When taken to a very low moisture content (in the neighbourhood of 1 per cent.), the shrinkage appears to be very much greater and most marked. This region, however, is not of interest. The strains set up by shrinkage caused by the removal of 1 per cent. moisture in a product containing 10 or 11 per cent. moisture would be far greater than those set up in the same way when the product contains 20 to 26 per cent. moisture.

In one case it was found that a sample of spaghetti, conditioned at 65 per cent. RH and transferred to an atmosphere of 100 per cent. RH for 20 hours, increased in length 6·4 per cent., the moisture having increased to 20 per cent. from 12 per cent. Thus the coefficient of moisture expansion was 0·008 per 1 per cent. moisture increase. This sample contained a high proportion of Manitoban wheat, which may account for the greater coefficient obtained than with the samples made entirely from durum semolina. The magnitude of the difference is so great that further work will need to be carried out on this point, since it tends to indicate that admixtures with Manitoban wheat would make the product more difficult to dry.

It is evident, therefore, that the last part of the drying process must be carefully controlled so that a correct moisture gradient is obtained in the material, thus relieving the internal stresses set up by the change in dimensions of the material, such changes being larger in this region than at the beginning of drying.

Rapid drying will lead to cracking or crazing of the finished product since the whole material is under severe internal strain. This behaviour is common in other fields of work such as in coating compositions, gums, lacquers, and adhesives, and the general principle in these cases to overcome this difficulty is to add a so-called softener or plasticiser. Lecithin

has been proposed as a plasticiser for macaroni products, and there is some indication that it serves some useful purpose in this respect.

The Drying of other Cereal Products

Although only a small amount of fundamental work has been done on the drying of macaroni products some has been carried out on other cereal products, and on proteins, which may have some bearing on the above problems. Flour, wheat, and cereal products have been shown by several workers to be hygroscopic. Frank[48] found no appreciable rate of increase of moisture between hard and soft wheat flours exposed to a damp atmosphere. Hard winter wheat of normal moisture content retained more moisture than soft winter wheat flour when exposed to a dry atmosphere.

T. H. Fairbrother[49] and also Smith and Mitchell[50] found that when flour is dried it loses hydration capacity so that it does not re-absorb all the weight lost in a dry atmosphere when it is later exposed to a damp atmosphere. Fairbrother[49] found that at 25°C. at controlled humidity there was a relationship between hygroscopic moisture and the relative humidity values of the latter from 15 to 90 per cent. Moisture was lost more rapidly in dry atmospheres than was subsequently regained on exposure to damp ones. Even partial drying of the flours at atmospheric temperatures apparently permanently reduced their water absorbing capacity. An S-shaped curve best expressed the relationship between relative humidity and moisture absorbing power. Thus the past history of a flour or wheat affects its moisture absorbing or its drying properties. Similar studies on macaroni products have not been made but would be of interest.

The drying of starch, flour, and gluten has also been studied by E. A. Fisher,[51] who found that down to 6 per cent. there was a direct proportionality between the drying rates and the moisture content. From 6 to 2½ per cent. a direct proportionality also exists, but of a different magnitude. This would appear to indicate that the water is held in a different way in the material. The straight line curves obtained indicate that the water diffuses out of the mass, like a gas, to escape.

Baker, Parker, and Mize[52] have determined the water binding capacities of starch and gluten separately by exposing purified salt-free samples to the vapour from the liquid supercentrifuged from doughs. When equilibrium was reached the amounts of water absorbed were calculated. This indicated that dry flour in doughs binds 27·3 per cent. of its weight of water.

This result is nearly the same as that found by Vail and Bailey,[53] who worked with salt-free doughs at 0°C. The addition of salt to the water in dough did not alter the concentration of flour solubles in the water of the separated solution, thus showing that salt in these concentrations does not alter the amount of free water in dough and hence has no effect on the amount of bound water. This indicates that Vail and Bailey's freezing point experiments and those just detailed, with salt-free materials suspended in vapour, give approximately correct results for the percentage of bound water in doughs containing salt.

The volumes occupied in dough by the solution containing solubles and by the hydrated insolubles, gluten and starch, were calculated from their known amounts and densities. In the particular dough they used, which has a 73 per cent. absorption, 47 per cent. of its volume was aqueous solution, 44·2 per cent. hydrated starch, and 8·8 per cent. hydrated gluten. That hydrated gluten and aqueous solution are closely associated and move together in dough round the starch was shown by removing the starch from the dough by a gluten-washing process using starch-free supercentrifuge as the washing liquid. The final, tender, separated gluten was impregnated with the dough liquid in amounts similar to those in dough. It would appear that such a mixture, which together comprises 55·8 per cent. of the dough volume, surrounds the starch and contributes fluid and elastic qualities to dough, while the starch adds puttylike properties to it.

These latter points have more interest from the point of view of the extrusion process, but the amount of bound water is of possible interest in the drying process since, after mixing and kneading, there will be present both free and bound water, and the possibility exists that the removal of the free water during the drying process may proceed by one mechanism until only bound water remains, which may then be removed by a different mechanism.

Plasticity changes during the removal of the two types of water may be different in magnitude—indeed, it would appear (*vide infra*) that the point where all the remaining water exists in a bound condition is a critical one in the drying process in that the plasticity is reduced to a level where internal strains are only slowly relieved by plastic flow when a moisture gradient occurs which includes this critical point.

Testing the Tensile Strength

The following method of testing the tensile strength of spaghetti long goods, devised and used in the author's laboratory, has been found to give consistent results and was used to measure the effect of moisture content of spaghetti on its breaking strength.

The apparatus consists of two upright posts, 6 inches high, set on a sliding bar and carrying knife edges at the top. The knife edges may thus be moved any distance apart and fixed in position by set screws. The rod of spaghetti to be tested is laid on the knife edges and a small, weighed, bucket is hung by a hook on to the exact centre of the stick. This hook is connected to a lever working the tap of a burette which delivers water into the bucket. When the bucket is in position, the burette tap is turned on full and water is delivered into the bucket until the stick breaks, when the fall of the bucket automatically cuts off the supply of water. The volume of water in millilitres plus the weight of the bucket is taken as the breaking strength of the stick. A large

number of experiments have indicated that a distance of 4 inches between the supports appears to give the best and most consistent results.

Good samples bend a great deal under load before breaking, and the extra length, required to allow it to assume the arc, is obtained by more of the rod slipping over the knife edges. The more flexible the rod, the more it bends before breaking, and the length of the spaghetti between the knife edges becomes greater by slipping. Results, therefore, on rods of widely different flexibility and strength are not strictly comparable.

The greater the distance between the knife edges, the more likelihood there is of a flaw occurring in a length of the rod, and the presence of such flaws tends to lower greatly the average value of the breaking strength in any one series of tests. The rate of loading is a further important factor, higher breaking strengths being given with higher rates of loading. In the author's apparatus, 50 ml. of water is delivered in 30 seconds.

As will be seen from Table I the modulus of rupture of samples of spaghetti increases with decrease in moisture content of the sample.

In this test the broken faces of the spaghetti were examined microscopically and the following three types of characteristics were observed:

(*a*) Bran particles appeared at, or near, the surface of one face of the break.

(*b*) Air bubbles in or near the surface of the break.

(*c*) A distinct honeycomb pattern of cracks. This pattern looked as if the individual semolina particles had not thoroughly cohered during extrusion.

Some samples showed no easily classified characteristics, and of the many samples examined, 57 per cent. showed characteristic (*a*), and 40 per cent. showed characteristic (*b*).

Another important factor was found to operate in this test, that is the need for conditioning the samples at a definite relative humidity for some 48 hours before testing. RH 65 per cent. was chosen as being about the average in Britain and was obtained by use of a desiccator having wet sodium nitrite crystals at the bottom. The connexion between percentage relative humidity and moisture content at equilibrium in the above Table is interesting and the figures were obtained using some 36 samples in each case.

TABLE I

BREAKING STRENGTH AND MODULUS OF RUPTURE AT VARYING MOISTURE CONTENTS

Equilibrium RH per cent.	*Moisture Content. per cent.*	*Breaking Strength. g.*	*Modulus of Rupture. p.s.i.*
0-5	1·0	80	2,580
47	8·6	83	2,407
65	11·8	77	2,233
86	15·5	56	1,624
98-100	21·7	Below 15	

Binnington and Geddes[54] have given results of their breaking tests on commercial and laboratory processed macaroni samples in a form which allows the calculation of the modulus of rupture. This appears to be higher for samples of commercial material than for laboratory prepared samples. Earle and Ceaglske[47] find the modulus of rupture of commercial spaghetti to lie in the region of 5,120 p.s.i. to 5,770 p.s.i.

Winston and Jacobs[55] used an apparatus similar in principle to that described above for testing the effect of additions of lecithin to the mixes on the tensile strength, and from their data the modulus of rupture can be computed as being similar to the figures obtained by the author.

Effect of Protein Content

Binnington, Johanson, and Geddes[56] reported the relation between protein content of wheat and the breaking strength of macaroni, the modulus of rupture being lower for a protein content of 10·5 per cent. than in a product containing 13·9 per cent. protein. The connexion between protein content and modulus of rupture derived from the above paper is not a straight line one, and there appears to be no information available upon whether the proteins from different types of wheat, *e.g.* Manitoban, influence the modulus of rupture to a similar extent. Such information would be of interest in assessing the desirability or otherwise of including other semolinas in mixtures for macaroni making.

The modulus of elasticity has been shown by Earle and Ceaglske[47] to rise rapidly as the moisture content is decreased below 26 per cent. Thus 26 per cent. moisture appears to be the absolute lower limit for the material to exhibit flow and thus allow strains caused by drying to even out during a rest period. A safer limit in factory work is probably coincident with the figure for bound water, *e.g.* 27 to 29 per cent.

Removal of Moisture during Drying

At comparatively low air-flow rates the author has found no constant rate period, probably because of the low rates of air flow employed. An inflection point in the drying rate curve for thin sheets of dough was obtained at 16 per cent. moisture content at higher air flow rates, but the significance of this is problematical. Earle and Ceaglske[47] found a constant rate period which ended at a critical moisture content of approximately 15 per cent. free water, and this was followed by the falling rate period. As might be expected, the higher the rate of air flow, and the drier the air, the quicker the drying, but there did not appear to be proportional connexion.

Distribution of Moisture

If partially dried macaroni or spaghetti is taken during manufacture and the end pressed into contact with paper which has been impregnated with cobalt chloride and then strongly dried, the blue paper turns pink where there is a high concentration of moisture. It is found that just after the initial drying period, and also soon after the commencement of the final drying period, the paper shows a strong pink where the centre of the stick has rested which shades off to blue at the circumference, thus showing that there is a greater concentration of water in the centre, lessening in amount to the circumference, *i.e.* there is a moisture gradient.

After drying and standing for some time, a uniform faint pink spot is obtained, showing the moisture is evenly distributed through the material.

In one experiment conducted by the author, a very thin sheet of macaroni was cut into five equal sized pieces which were laid one upon the other and wrapped in tin foil with just one large face exposed. Evaporation could, therefore, take place only from this face. A blast of hot air from a hair drier was directed upon this face, the whole being enclosed in a box with a vent in the lid.

The relative humidity of the air was 69 per cent., and the distance of the air blower from the face of the material was such that the temperature of the air at the face was 99°F. After three hours the sample was removed, the layers separated, and pieces cut from the centre of the face. The moisture contents of the centre and outside pieces were found to be 41·8 and 22·8 per cent. respectively. There was thus a difference of 19 per cent. in moisture content between the inside and the face of the test piece. The moisture content of the original dough was 43 per cent.

Laboratory Drying of Macaroni

If the data given by Binnington and Geddes[41, 54] for the laboratory drying of macaroni are examined, it is found that the moisture gradient over 0·06 inch is as shown in Table II below.

The short preliminary drying of the samples may possibly be responsible for the high moisture gradient in the initial stages of drying.

This method would appear to be a good one for following the drying of macaroni, under varying conditions, in the laboratory, when an experimental drying chamber having temperature, humidity, and air speed controls is available.

Requirements for Correct Drying

The dough when extruded has a moisture content of about 44 to 46 per cent. (dry weight basis), but after drying for some time the outside is drier than the inside portion. A normal moisture estimation gives only the average figure for the whole of the mass.

When first made, the dough is plastic, and during drying a point is reached where it loses its plasticity and the modulus of elasticity starts to rise rapidly. Loss of plasticity brings about a loss in the power of the material to correct internal strains (introduced by the greater contraction of the drier portions of the product) by flowing.

Loss of plasticity appears to occur at a moisture content of about 27 per cent. Rather significantly, the bound water of flour doughs has been found by several workers to be in the neighbourhood of 27·3 to 28·6 per cent. It is not known whether the value for bound water in durum wheat is significantly different from that for ordinary wheat.

It would, therefore, appear that when the dough contains about 29 per cent. water, it can flow to relieve internal strains, since it is still in the plastic state, but below this figure and certainly below 27 per cent. it cannot, since no free water is present and its plasticity is lost.

If a sweating period is introduced after a period of drying, the moisture content of the material before the sweating process is started will differ according to the relative humidity of the drier. In an air tight drier, where a very high relative humidity can be obtained and maintained, the overall moisture content of the goods before sweating should be not less than 27 per cent., while under conditions yielding a lower relative humidity a safe figure would probably be about 30 per cent.

TABLE II

Drying Time hr.	*Moisture Content. Outside. per cent.*	*Moisture Content. 0·06 Inch from Face. per cent.*	*Gradient per cent.*
2·5	38	45	7
5	30	42	12
7·5	22	38	16
10	20·5	32·5	12
15	19	23	4
35	16·5	18·75	2·25

In the first case, the outside of the material can pick up moisture to regain the limit of bound water, and a little extra to restore its plasticity; in the second case the moisture present will tend to be lost down to the required limit, and in both cases there will be a simultaneous lessening of the moisture gradient throughout the material restoring the plasticity, and, therefore, allowing internal strains to be relieved by internal flow.

If the material is dried below these limits before sweating, it is extremely doubtful whether a product free from cracking can be produced however carefully processed it may be in the later drying stages, since internal stresses are already present if there is any moisture gradient, which there is bound to be, unless the drying has taken very many days or weeks.

The material must, therefore, be sweated when its moisture content is from 28 to 30 per cent. to allow the moisture gradient to disappear, *i.e.* the moisture to even out. This, in turn, allows internal stresses to be relieved by viscous flow.

Below this moisture content this latter effect cannot occur.

If, during the sweating or remoistening period, the moisture present is sufficient to allow viscous flow, the material will relieve itself of strain. If, however, at the same time, the moisture gradient is not allowed to even out sufficiently before drying is restarted, the material will pass from the stage where viscous flow is possible to the rigid condition. It will be free from stresses but have a large moisture gradient.

When in the final stages this moisture gradient is removed, it will leave the material permanently in a state of internal stress owing to the larger contraction of the previously wetter portions, and such stresses cannot be relieved by viscous flow. Since the inside of the product is the wetter during the drying process, the stresses will be greater on the inside than the outside and cracks will start from the inner wall and pass towards the surface, *i.e.* from the region of greater to lesser strain. In such cases the material

appears good during the process but cracking commences at varying periods after stopping the fans.

Outside and other Cracking

If a product passes from the plastic to the rigid state with a small moisture gradient, a strong product will be obtained at the end of the drying. Atmospheric moisture will tend to cause cracks starting from the outside.

Changes in moisture content of the product due to changes in relative humidity in the factory can quite well amount to 2·5 per cent., and such changes, especially if brought on suddenly, can well cause danger of crazing. Some attention should be paid, therefore, to the storage conditions.

In conclusion, there is a possibility that the inclusion of Manitoba wheat in a macaroni product may cause the drying to be more difficult than if straight durum alone is used, owing to the different contraction on loss of moisture. Manitoba/durum mixtures should, however, follow the same general pattern as straight durum products, and the same general considerations should apply.

(To be continued)

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FUTURE ARTICLES

ARTICLES to be published in forthcoming issues of FOOD MANUFACTURE will include the fifth part of "The Chemistry and Physics of Macaroni Products," by J. A. Radley, M.Sc., F.R.I.C., and an illustrated description of a British fish canning factory.

Science Epitomised

IF it were necessary to explain, within the covers of a single volume, the meanings of 10,000 scientific and technical words, it would not be unreasonable to expect such a publication to be a weighty tome of somewhat bulky proportions. However, a recently published dictionary* of this kind is neither weighty (in avoirdupois or subject matter) nor bulky; it is, in fact, a compact little volume, containing many illustrations.

Meanings are given for words as familiar as "knocking" ("the noise 'ping! ping!' made by a motor car if it is suddenly given more petrol, *e.g.* when going up a hill in top gear"), and as unfamiliar as "archaeopteryx" ("earliest type of bird as shown by fossils"). Among other specialist words are urea-formaldehyde plastic, isochronous, kinaesthetic imagery, eudiometer, and kataphoresis, to mention only a few. Many principles and theories are also expounded, such as Faraday's law of electrolysis and Einstein's principle of relativity, but though the mysteries of the isosceles triangle are explained, our old friend Pythagoras and his theorem are missing.

One of the difficulties in compiling a reference book such as this is in deciding what should be included and what should be omitted; in a preface the authors have explained the rules they have adopted. One of these is that words should not be included which are adequately explained by an ordinary dictionary; no word may be omitted because it is too difficult to explain, but only because the explanation would take more space than is justified by its importance.

The explanations are extremely clear, with not more than one cross-reference, and are of such a length as to give an adequate idea of the meaning (sometimes as much as half a page, or more has been necessary); nevertheless the book is not an encyclopaedia, and deals with words, not subjects. The system of pronunciation is fully explained, as are the chemical signs used to illustrate the various chemical formulae.

According to the sub-title of this book, the words in 50 subjects are explained "as to a person who has little or no knowledge of the particular subject," but this does not mean that its interest and usefulness is exclusively for the enquiring layman. There must be few people to whom technical terms on subjects ranging from medicine, chemistry, chemurgy, electricity, mechanics—to name only a few—are all familiar, and probably none who do not frequently find it necessary to check their knowledge of matters not strictly coming within their particular sphere.—P. M.

* *An Explaining and Pronouncing Dictionary of Scientific and Technical Words.* By W. E. Flood, M.A., Ph.D., and Michael West, M.A., D.Phil. Pp. 397 + viii. Longmans, Green. Price 12s. 6d.

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Orders for any of the books listed below, or scientific and technical books in any language, may be placed with the Books Department, FOOD MANUFACTURE, *Stratford House, 9, Eden Street, London, N.W.1. A selected stock of books is carried and may be inspected at the above address. Prices given do not include postage.*

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Hildreth, E. M. *Elementary Science of Food.* Allman. Pp. 298. 7s. 6d.

FAO and Fertilisers

"If full use is made of present scientific knowledge and technology for crop production in all parts of the world, great advances can be made towards building healthy lives and providing adequate diets for all. One of the strongest links in the chain of successful crop production is the efficient use of fertilisers. The farmer himself has to forge it, but he needs technical guidance and, under some conditions, economic assistance, if this link is to be strongly made." These are the concluding sentences of a recent publication,* the deliberate selection of which does not constitute a criticism of the arrangement of this book; it is a recognition of the fact that the evidence presented by so many expert agriculturists proves beyond possible dispute that final conclusion.

Here, indeed, is the essence of world knowledge about fertiliser use, distilled by authorities from many countries and skilfully blended by the editor, Vladimir Ignatieff. It is intended "for agricultural administrators and advisers who work with farmers and farm organisations." In a practical sense, this may well be a proper aim, but the book will surely have a far wider circulation so that it will reach state administrators and politicians and journalists—all those people, in fact, whose influence upon policies and actions is often more decisive than the influence of the adviser on the spot.

It is never enough to make the farmer fertiliser-conscious; at best, it is only half the battle. It may, indeed, be the first half, but the second is an issue for a community as a whole. Prices paid to farmers for their crops must be such that an adequate margin for fertiliser purchase is provided. The materials necessary for sufficient fertiliser production must be developed at home or imported from abroad; moreover, where other industries compete for the same materials, these economic clashes must be resolved, bearing in mind the importance of fertilisers.

In the use of fertilisers, the time factor is of enormous significance; distribution in time for proper application is just as important as production in sufficient quantity. A community must devote adequate storage space and transport facilities to its fertilisers. Matters such as these are outside the control of the agricultural adviser—he can but make recommendations and hope they will be supported.

Perhaps the greatest world service this book could perform would be to convince industrialists, politicians, administrators, and the rest that these materials are neither luxuries, nor profitable improvisations, but commodities indispensable to the life of every country.

While the book does not aim at being an exhaustive technical treatise, it covers an admirably wide field in clear, non-technical language. The role of the chemical fertilisers is not exaggerated. The need to co-ordinate a farm's fertiliser policy with all the other factors in crop production on that particular farm is emphasised, as is the complementary necessity for supplies of organic matter; in two of the eight sections of the book considerable attention is devoted to animal manures, composts, sewage products, and crop residues. The time has long since gone when the fertiliser enthusiast could hurl entirely chemical ideas into the complex biological, physical, and only partially chemical equilibria of the soil.

The book and literature references at the end of each section are admirable. The illustrations must also be especially commended; they are superb examples of the clear-cut demonstration and are drawn from all over the world.

* *Efficient Use of Fertilisers.* Edited by Vladimir Ignatieff. Pp. 158+ix. Published for FAO by Leonard Hill Ltd. Price 10s.

Bridled Fermentation of the Grape

In the classical fermentation of the grape the ebullient activity of the yeast is allowed full play by the continuous escape of the generated carbon dioxide (ignoring the champagne process for the moment) which, if retained, would inhibit the vital processes of the organisms. The process whereby the carbon dioxide is deliberately used to restrain the activity of the yeasts has therefore been given the name of *gezügelte Gärung* ("bridled fermentation") by one of the pioneers of this unorthodox mode of winemaking, who describes it in a recent German book.*

Briefly, the carbon dioxide formed in the course of fermentation of grape juice in high pressure tanks is not allowed to escape from the very start so that the pressure rises, yeast proliferation is reduced and, at the maintained high pressure, the fermenting power of the still-existing yeast cells is diminished.

Another fundamental departure from classical methods consists in the use of glass-lined steel tanks in place of the traditional wooden vats. In fact, bridled fermentation marks the introduction of scientific control on a conspicuous scale into a field which, until recently, had lagged behind the brewing and other beverage industries in this respect. It should be pointed out, however, in qualification of this statement, that high pressure tanks have been used in champagne manufacture for some considerable time.

In this concise account of the present status of bridled fermentation, the author deals in successive chapters with normal and restrained fermentation, high pressure tanks and their accessories, the practical realisation of bridled fermentation in connexion with the processing of German 1949 and 1950 grape juices, and modifications in technique demanded for the production of red and sparkling wines. At the end of the book the firm conviction is expressed that, in Germany at any rate, this fermentation process has a bright future.—L. L.

* *Gezügelte Gärung.* By W. Geiss. Volume 3 of a series on new cellarage techniques. Pp. 78. Joh. Wagner und Söhne KG, Frankfort-on-Main. Price DM.2.50.

Scotland's Egg and Poultry Industry

The contention that Scotland's table poultry industry must be expanded to operate on an all-the-year basis and that full use of refrigeration and other modern facilities should be made has become stock comment in the industry. A packing station which is playing a major role in achieving this end and which plans further development is the one at Airdrie.

FOUNDED in 1942, the Airdrie Station is one of the best established units in this field. Before 1953, it is planned to install a quick freezing plant to handle eviscerated quick frozen table birds and frozen eggs.

A recent development is an extended table bird trade, carried out in co-operation with Lochend Egg and Poultry Packing Station in the Lothians, of which Mr. Park, owner of the Airdrie Station, is a partner. These two stations have done a considerable amount of work in the table bird industry, and are handling substantial supplies for the trade.

Although this venture is only in its infancy, the Airdrie Station is handling between 1,500 and 2,000 birds weekly. Since the requirements of their customers are varied, the policy has been to operate on as wide a basis as possible. The birds are delivered fresh, cold-stored fresh, or eviscerated and quick frozen.

The poultry is scalded before plucking by machinery.

Poultry is plucked by a high speed rotary rubber fingered unit.

There has thus been little opportunity as yet to organise an assembly line process such as is the practice in America; indeed, there is no certainty that the installation of the new quick freezing plant will encourage factory line processing methods. There is a certain resistance to quick frozen eviscerated table poultry in Scotland, and this alone makes it difficult to organise on a factory basis. The best policy may be rather to adapt and operate as demand dictates, while making the fullest possible use of the new facilities to the limit of customer demand.

Intake of Poultry

At present the Airdrie Station collects birds and eggs, which remain their main interest, from a wide area covering Lanarkshire, Dumbartonshire, Stirlingshire, and Ayrshire. Up to 2,000 birds a week are collected from farms; these are plucked partly by hand and partly by machine, weighed, graded, and allocated for use according to current demand. Some go fresh to the wholesalers and retailers, some are cold-stored, and others are eviscerated and quick frozen, use being made at present of existing facilities outside the premises for this latter purpose.

The liquid egg trade comprises a substantial section of business at Airdrie, output being in the region of 3½ tons per week. The new quick freezing plant, which is of the freezing plate type, will have a capacity of 5 tons of liquid egg, or an alternative capacity for other products; it will be of positive use in the frozen egg trade which has been developed extensively. The station has designed and installed its own beating plant to prepare eggs before freezing.

Cut and Packed Poultry

The probability of handling cut and packed poultry has been mooted from time to time. Mr. Robertson, manager at Airdrie

The candling of eggs reveals any internal defects. The egg, broad end uppermost, is held against the aperture of the candling lamp, the ease of movement of the yolk giving information about internal quality.

Handling of Shell Eggs

The egg trade of the station is suffering from the present diversion of supplies. An estimate of this diversion is possible because of the period in 1950 when the Black Market was virtually eliminated by reason of peak home supplies and ample imports. Basing that as a reasonable maximum intake, the 1951 intake dropped by as much as 75 per cent., leaving packing stations with only a fraction of the shell egg trade which they should now be handling.

This station is no exception, and is consequently working at a low level so far as shell eggs are concerned.

The figures quoted indicate the problem facing the packing stations at the present time. The solution is to allocate feedingstuffs on the basis of eggs delivered to

and a former poultry farmer, indicates that the packing station is prepared to handle this trade if demand indicates its need. Like other stations, however, they prefer to operate as wholesalers and to service firms with facilities to handle table birds, either whole or in portions.

To date there has been no real demand for cut poultry at the packing station stage, but it is felt that this work might be developed with success; the tendency is rather to leave this matter to the firms actually in close daily contact with the consumers and to allow them to determine how the product will ultimately be sold.

Above: **On arrival at the station from Lanarkshire, Dumbartonshire, Stirlingshire, and Ayrshire, the eggs are passed through the grading machine.**

Right: **The station has designed its own beating plant to prepare eggs before freezing. The present output of the freezing plant is 3½ tons per week.**

the grading stations, a logical argument if the Government plans to back the stations, but not necessarily one which will appeal to the producer.

Other points from this area are that the quality of eggs is good, with a small number of rejects; that table birds are, on the whole, sound, with the normal proportion of poorer supplies.

In spite of difficulties, a comprehensive marketing programme embracing shell eggs, frozen eggs, fresh table birds, and quick frozen birds is being worked out with considerable success at Airdrie.

The activities at Airdrie and Lochend provide a useful indication of the pattern of development at these stations. The original conception of grading and packing eggs has succeeded, although hampered by present conditions.

There has been less immediate acceptance of the same policy as applied to table poultry, although the industry is convinced that grading and marketing will come in due course. The plant now being considered and installed by the grading stations is a logical development of that belief.

Already experience at these stations shows that a small section of the community is quality-conscious. This section includes consumers who buy direct, often sending long distances for quality birds, retailers who want to stock quality poultry for discriminating buyers, and caterers who want fine birds for special occasions.

A smaller quality bird, although more costly, is ultimately cheaper in the long run than a heavier poorer bird. In this way the graders claim that they can save the buyer's money, apart from supplying better food.

Turkey Grading

The stations interested in this work are also developing turkey grading, packing, and distribution, which has now become more of a regular than a specialised trade.

The recent development of American Broad Breast types in Britain has helped to increase interest in this direction, although

(*Concluded at foot of next column*)

the older Whites are also proving admirable sellers of good quality. In addition to improved handling and storage, the stations are expanding distribution by better packaging. Polythene bags are used to store in the freezing stage, while posted birds are also wrapped in fine paper, heavy paper, and plastic taped. Where more than one bird is sent the practice is to pack them, wrapped in this manner, in boxes. Although expensive, such packaging is all part of the policy of giving improved quality food, at the keenest price, a policy which is resulting in a steady build-up of the stations.

Grassland Improvement

COMPILED by a member of the Agricultural Division of FAO with the help of other members of this organisation, and with the advice and criticisms of no less than 77 experts and scientists, all of whom are recognised authorities on pasture and grassland management, a recently published book* can be described as an authoritative statement on the all-important question of how natural grasslands can be made more productive, and how waste land, with a favourable climate, can be converted into rich pastures.

Approximately 90 per cent. of the world's food supply depends on the cultivated lands of the earth, leaving only 10 per cent. to come from grazing lands. The importance of this grazing land cannot be too strongly emphasised, although up to now not enough use has been made of it.

This book has been compiled in an attempt to solve some of the problems of trying to improve the productive and carrying capacity of grasslands all over the world. It does not confine itself to one particular area, but is world-wide in its scope and includes lengthy sections dealing with the problems of pasture and range management in the tropics and sub-tropics where pastures are, on the whole, of low fertility and carrying power, owing to the absence of proper management and consequent neglect.

The preparation of this book has been undertaken by FAO as part of their task of securing a sufficient nutritional standard of food for the peoples of the world. It should help people all over the world to conserve and put to better use the two natural resources most essential to life and most often in danger of wanton use—the land and the water.—H. T.

* *Improving the World's Grasslands.* Prepared by A. T. Semple. Pp. 147+xiii. Illustrated. Leonard Hill Ltd. Price 10s. 6d.

The Search for Good Food

THE Good Food Club, which has for its President, Founder, and Editor Mr. Raymond Postgate, is one of the easiest to join, membership being secured by the simple means of purchasing a five shilling book.* It has no organisation, funds, or officers, but its rules are very stringent. (1) No advertisements are accepted from hotels, inns, cafés, restaurants, or other places which might qualify for an entry. (2) No member of the club will accept free meals or free hospitality from any such establishments. (3) No person is authorised to promise or withhold an entry in the guide for any consideration, and anyone pretending to be able to do so should be treated by the innkeeper as an imposter. (4) Recommendations are not accepted from the innkeepers or their employees. (5) No payments are made for recommendations.

The book has been compiled by unpaid contributors whose short reports of inns and restaurants throughout the length and breadth of the country describe the food and drink to be obtained there and the prices charged.

The guide contains between 800 and 1,000 annotations and to the casual reader is an apotheosis of British food. The explorer of gastronomical bent here has his choice of "traditional English fare — cheap and good" to "varied food, high price but worth it."

* *The Good Food Guide, 1952-1953.* By Raymond Postgate. Pp. 298+vi. Cassell. Price 5s.

Flour Confectionery in America

Many particulars of machines and methods which will be of use to British cake and biscuit manufacturers and suggestions for increasing productivity in this country without losing or impairing the essential quality for which British biscuits and cakes are justly famous all over the world are described in a recently published report.*

IT is difficult to compare productivity in the American biscuit and cake industries with that in the British because the types of biscuit made in the two countries are fundamentally different. Some 60 per cent. of American biscuits are of the unsweetened cracker type as against less than 15 per cent. in the U.K. This important variation is due to differences in taste and in eating habits. Americans do not, as a rule, take mid-morning coffee or afternoon tea, which are both established British customs and account for a large consumption of biscuits and cakes. On the other hand, they eat more cracker biscuits in place of bread, for example with soup, and at breakfast they consume large quantities of cakes, particularly doughnuts. Unsweetened cracker biscuits in the U.S. are always known as sponge goods, and sweet biscuits as cookies.

Plant Layout

The modern bakeries seen were mainly of one storey, but there is nothing to prevent a first-class modern layout being achieved in a multi-storey building provided there is adequate length; in fact, it is often simpler to arrange for the various types of production to arrive economically at a despatching point in a multi-tiered rather than in a one-storey building. The former type is essential for the storage and mixing of ingredients, if flour and sugar are to be fed by gravity from the store to the mixing room, and dough from the mixing room to the machines, although the rest of the bakery can consist of one storey only. In recently constructed bakeries and in those being built at the present time, much thought has been given to the bulk storage of ingredients. This entails the provision of special storage accommodation which, in the case of flour and sugar, may take the form of tall silos.

Continuous Flow Line

The new plants have been laid out mainly with a view to the use of band ovens, which are usually about 300 feet in length, although some are considerably longer. In the mainly single-storey buildings the ingredient stores, machines, ovens, packaging, and despatch warehouse are arranged for continuous flow, but in such buildings this "in line" layout necessitates buildings of great length—sometimes of 1,300 feet or more.

Process work, such as chocolate enrobing, cream sandwiching, marshmallow depositing, and icing, is in most plants carried out in the main bakery and not in separate rooms. In the case of chocolate, air-conditioned or temperature-controlled rooms are sometimes provided for the packaging operation and for the stocks of the finished article.

Extensive Conveyor Systems

The packaging department is a most important part of the layout. Much thought has been given to planning conveyor systems to carry the cartons to the packers, and provision has been made for switching the output of one machine or one oven to another group of packaging machines in the event of a breakdown.

The greater use made in the U.S. of conveyors undoubtedly helps to increase productivity.

In planning bakeries, American manufacturers have much more regard for mass production and are not prepared to devote space for hand operations such as decorating and the packing of elaborate assortments. Further, to avoid the possibility of bottle-necks they are more prepared to design their product to suit the machinery.

Biscuit Production

Except for a small quantity of Canadian origin, all flour used in the manufacture of cakes and biscuits is milled from home-grown wheat. Many types of wheat are available, but the tendency of millers is to specialise in a few varieties for cake and biscuit flours.

The general extraction rate of flour in the U.S. is 72 per cent. as compared with 81 per cent. in the U.K. and special patents of lower extraction are available when required. The American public, like the British, prefer their biscuits to be made with a white flour, and the lower extraction rate makes the American flour much more suitable for bulk storage, and eliminates technical difficulties in production experienced with flour of a higher extraction rate. There is no doubt that biscuits made from the 72 per cent. extraction flour will keep much longer than identical biscuits made with the 81 per cent. type.

In addition to white flour, whole wheat flours are used in the U.S. (such as "Graham"), milled to comply with the specifications of the National Bureau of Standards.

Nearly all flour in the U.S. is delivered in multi-walled paper sacks, of which there are many different kinds. A few millers use cotton bags. The law in most States enacts that all flour must be sold in one-trip containers, and the Pure Food and Drug Administration considers that by this means the maintenance of purity and hygiene is more thorough.

Shortenings

A much greater variety of shortenings is available to the American manufacturers and there is a free choice. The chief oils observed were cottonseed, groundnut, coconut, palm kernel, and oleo; butter and lard were also in ample supply.

* *Cakes and Biscuits.* Pp. 68+x. Anglo-American Council on Productivity. Price 4s. 6d.

In addition to the hydrogenated straight vegetable oils and animal fats there are in the U.S. a number of excellent proprietary shortenings which are supplied ready plasticised and usually have had antioxidants added as a preservative.

Sugar and Syrups

In the main, sugar is received in granulated form in paper sacks containing 100 lb. Liquid sugar is used only in the manufacture of cake, but experiments are being carried out to see whether it can be used in biscuits.

The use of invert sugar in the U.S. is extensive; the fast baking makes its use in the dough essential in order to give crust colour. Glucose (corn syrup), molasses (treacle and golden syrup), maple syrup, honey, and malt extract are in general use.

Handling and Storage

In general, storage of raw materials is in special rooms, temperature-controlled according to need. When not delivered in bulk, all raw materials on arrival are transferred to pallets for ease of handling, transport, and storage.

In only one bakery visited was there a complete installation for the bulk handling and storage of flour, but the system is being used in at least two other plants in the U.S. In principle, the flour is sucked from the freight car into large storage bins, each of which may hold up to 60,000 lb. There are many bins in an installation, and the selection of the bin into which the flour is to be put is made from a centrally situated panel which controls the whole system.

The same principle is being applied to the bulk handling of sugar, but this problem is simpler than that of flour.

Mixing Machines

Among the types of mixing machine used are three-spindle vertical mixers for sponge goods and horizontal drum type with either fixed or tilting barrels, water-jacketed high-speed mixers, and sun-and-planet type whisk cake mixers for sweet goods.

For comparable doughs, mixing times are very similar to those in the U.K., and the human element still plays a large part in deciding when the dough is correctly mixed. However, an effort is being made in some bakeries to introduce automatic control of mixing times.

Dough temperatures are recorded in most bakeries, and this applies particularly to the manufacture of sponge goods.

Biscuit Processing

No chocolate enrobers were found in a line with the oven. They were similar to those in the U.K., but wider, up to a maximum width of 44 inches, with straight-through cooling on plastic type bands in the majority of cases. Cooling times cannot be compared with those in the U.K. because, particularly in the hot summer months, a "chocolate product," which is compounded from cocoa and a high melting point vegetable oil, is used instead of couverture. The use of this product does not give such a good appearance to the covered biscuits, and many firms discontinue the manufacture of chocolate lines completely during the hottest weather.

No automatic tempering of the chocolate was seen. The melted chocolate is always conveyed by gravity pipe line or by pump to the enrober.

Enrobing and packing are usually carried out in the main factory, and no effort appears to be made to vary the temperature of the cooler to compensate for changes in the dew-point of the packing room.

Cream Mixing and Filling

The method employed in the mixing is extremely interesting and could be employed in bakeries in the U.K. with advantage.

The ingredients for a large batch, possibly 3,000 lb., are assembled in a large stainless steel tank. As a rule, lecithin is used to aid emulsification of the coconut fat, sugar, milk powder, salt, flavour, and colour, and it also serves as an antioxidant. In this tank there is an agitating device to keep the contents well mixed at a temperature of 98°F. From the tank the mixture is piped through an emulsifying machine which gives a continuous supply of cream to the hopper of the sandwiching machine at 78°F.

One such emulsifier operated in two stages: (*a*) a mixture from the bulk storage tank was piped into the Votator where emulsification took place with little loss of temperature, and (*b*) immediately afterwards it was passed through a second similar emulsifying unit encased in a cooling unit which reduced the temperature of the cream to 78°F., and from this point it was pumped to the hopper by pipeline.

Experiments are being carried out to incorporate air into the cream mixture at the second emulsifying stage, to give added lightness. In one case, between the emulsifying unit and the creaming machine hopper, a storage tank has been fitted into which the cream is pumped from the emulsifier and is then transferred to the hopper of the creaming machine by means of a pump. This system of mixing the cream not only gives a very consistent cream filling, but also makes for great cleanliness.

Marshmallow Mixing

Like cream filling, the mixing of marshmallow is usually done by a continuous process. One of the most efficient methods seen involved the use of the following equipment.

1. Stainless steel tank for soaking the gelatine.
2. Stainless steel jacketed tanks with agitators (steam and cold water circulating coils).
3. Horizontal stainless type tank for storage of invert sugar.

This sugar is pumped through a flow-meter which measures the exact quantity required.

The sugar is weighed and emptied into the first of the series of jacketed tanks, followed by hot water, the required quantity of which is automatically measured through a meter. The temperature of the contents of the tank is then raised by means of the steam coils, while the agitator is in motion. The invert sugar is pumped into the tank with a resultant drop

in temperature, the prepared gelatine solution added and tank contents raised to the desired temperature. The cooked mix is pumped first into the cooling and storage tank and then to a continuous emulsifier, which in turn delivers the mallow to the hopper of the marshmallow depositor.

The discharge temperature of the mallow from the storage tank to the emulsifier is 108°F.

Cake Production

The biggest selling lines in the U.S. are undoubtedly those which lend themselves most readily to mass production; this demand has been created by sales policy and advertising to enable manufacturers to produce their cakes at prices competitive with many other foods available. Such a large demand for individual lines enables manufacturers to mechanise their plants completely, thereby increasing productivity and reducing cost.

The flour used is invariably the high-ratio type of low extraction rate, very finely milled and chlorine-treated.

In two plants liquid sugar is being used. The concentration is 67·5 per cent. sucrose and 5 per cent. invert sugar; it is bulk delivered and stored at 85-90°F., the whole system in one plant being continually pumped round to ensure no loss of temperature in pipelines. The use of liquid sugar facilitates handling, thereby reducing cost, and for the type of product it is highly suitable, giving a moist and soft crumb.

Most of the fruit is of Californian origin; it is of excellent quality and reaches the bakery in a clean condition, having always been previously washed and picked over. When it was washed again in the bakery very few foreign bodies and stalks were found and little crushed fruit.

Prepared Mixes

Prepared mixes consist of varying percentages of dry mixtures, shortening, flour, sugar, egg, etc., produced very often by the milling industry in automatic plants. Biscuit manufacturers do not use them, but one or two cake bakeries do. They are sold to the retail trade in small packs for use by the housewife.

Sales of prepared mixes have increased sevenfold since 1946 and have slightly affected the sale of cakes. Competition from these prepared mixes, which may continue to increase, emphasises the importance of maintaining a high standard of quality of cakes and biscuits in both countries.

Mixing Plant

In general mixers are of the sun-and-planet whisk type, of 340 quarts capacity, and very few horizontal barrel mixers were seen. Because such a high percentage of sponge-type goods is made, a system of emulsification with continuous flow to depositors is a conspicuous feature of the cake-mixing room.

The emulsification of batters and the introduction of air at this stage aid the production of the large-volume cake demanded by the American public. Emulsification of the U.S. cake batters is said to increase cake volume by 25 per cent. This method is strongly recommended, for, in addition to ensuring a consistent flow of batter to the depositor, it is more hygienic. A continuous flow emulsifying machine for cake batters is not as yet available in the U.K., but a batch air-whisk type is being used very successfully. The home manufacture of a continuous flow machine should be given high priority in the near future.

Automatic Flow Bakery

Only one bakery was seen in which there was a continuous flow process from the mixing to the packing stage.

Apart from mixing, two operators are capable of running this plant turning out 500 cakes a minute, *i.e.* 10 pans a minute, each containing 50 cup cakes. The first operator looks after the greaser and depositor, and the second dumps the cakes from the trays and feeds the tins into the washer. The remarkable and outstanding features of this plant are:

(*a*) the smoothness in the flow of production;

(*b*) the output obtainable with so little labour;

(*c*) the comparatively small space the plant occupies;

(*d*) the sound functional design and overall efficiency.

Cream Filling

In one bakery, cup cakes were being filled by an adapted depositor while still in the baking tins. This was done by having pointed tubes at the die deposit, so that the table movement caused the tubes to penetrate the cakes and inject cream into the centres of 36 at one stroke at the rate of 1,440 cakes a minute.

Packaging

The Team did not see any biscuits packed into tins of the type so generally used in this country. Where bulk quantities are required, as for hospitals, institutions, and hotels, biscuits are packed in non-returnable wax-lined cardboard caddies. Packaging of biscuits in small units is much more necessary in the U.S. because of the special needs of the self-service stores and supermarkets. As a result, in recent years there has been great development of packaging machinery for this purpose, although one prominent American manufacturer stated that, in his opinion, the development of packaging machinery had not kept pace with that of other biscuit machinery and ovens.

The layout of the packaging equipment in American biscuit factories is most impressive, and often almost as much space is devoted to packaging machinery as to production.

The flow of biscuits from the ovens to the packing machines is uninterrupted; there is no question of storing them for packaging at a later date (the only store being on the cooling conveyor). This means that an adequate number of all machines must be provided, to allow for the switching of production in the event of a breakdown of individual units.

Many firms are at present trying to develop a machine which will transfer biscuits automatically from the packing band to the carton or wrapping machine, but no details are yet available. It may be that the biscuits will have

to be automatically wrapped before being cartoned.

With regard to the wrapping of processed biscuits, however, the feeding of cream sandwich biscuits directly from the cream sandwiching machine on to flat boards and then automatically into a wrapping machine was noted.

Bakery Research

Bakery chemists in the U.S., as in the U.K., are carrying out much research in the problems connected with the industry.

The functions of bakery laboratories in the U.S. are very similar to those in the U.K. In some bakeries a constant inspection is made by the chemist during production and processing so that records can be kept and immediate advice given to the management when necessary. Usually it is the responsibility of the laboratory staff to inspect records of temperature and humidity during manufacture and processing.

Chemical Additives

The U.S. hearings on bread standards have, for the time being at least, brought the edict from the Federal food and drug authorities that polyoxyethylene stearates and polyoxyethylene substituted esters are prohibited. Their attitude is that it is safer to prohibit the widespread use of such substances until they are proved to be harmless on prolonged ingestion. Glyceryl monostearate may be, and is, used up to 25 per cent. of the weight of shortening and in some instances it is very useful for its emulsifying properties.

Two groups of substances have been developed and are being used as crumb softeners and/or anti-staling agents. One, the "Span" series, consists of partial esters of sorbitol anhydrides and the common fat-forming fatty acids (stearic, palmitic, lauric, and oleic); the other, the "Tween" series, is derived from the Span products by condensing polyoxyethylene chains at the non-esterified hydroxyl positions. Both groups have been found to be excellent surface-active agents.

The Mixatron

A major problem in mixing, particularly since the introduction of power-operated mixers, is the determination of dough consistency. Bakers have long recognised the importance and need of dough uniformity, for without it the value of mechanised equipment is greatly diminished.

Over the last 40 years much time and money have been expended on the problem of dough consistency, and gradually there have been evolved, particularly in laboratories, various devices which are reasonably efficient—for example, the farinograph. With such apparatus it is possible to obtain much useful information on dough characteristics; but in spite of this advance in technique and testing there remain other factors which affect dough consistency, such as:

1. Variation in chemical and physical properties of dough ingredients, particularly flour.
2. Inaccuracy in dispensing and weighing ingredients.
3. Variations in dough temperature and time of fermentation.
4. Human error in determining correct mixing time.

Any device which will reduce the possibility of error from any of these causes would be a valuable aid to productivity.

As a development of the farinograph, which relates dough consistency to mixing time, the Mixatron gives a characteristic curve, the peak of which denotes maximum dough development, especially in sponge doughs, prior to gluten breakdown. The Mixatron avoids the peaks and valleys obtained with the normal recording watt-meter, which render interpretation difficult, for in this device the induced currents are picked up from the mixer motor, amplified, and integrated into a single curve which can be correlated with the consistency of the dough.

Teflon

The claim that "nothing sticks to P.T.F.E." (polytetrafluoroethylene resin—Teflon) seems to have encouraged experiments with rolls covered with a half-inch layer of Teflon in several bakeries in the U.S.

The substance is a plastic which can be supplied in sheets, rods, tubes, tape, and moulding powder.

The U.K. is not behind the U.S. in this respect; I.C.I. have experimental rollers in operation in one bakery, and a sheet pressure plate in another, which are giving great satisfaction in preventing dough sticking. This material (Fluon in the U.K.) may well revolutionise dough-handling machines and make possible a great saving of flour used for dusting.

The foregoing deals with some of the manufacturing aspects of the report, which covers a very large amount of ground. The subjects of personnel management and labour relations; trade unions and union contracts; wages; price control; costing; and marketing are treated in their respective sections.

Perhaps the most important of the Team's recommendations to increase productivity in the U.K. is that the extraction rate of flour used in the manufacture of biscuits and cakes should be reduced to the pre-war figure of 72 per cent. It is also suggested that the Ministry of Food should introduce strong measures to ensure greater cleanliness and higher standards in imported vine fruits, that metal drums used for the conveyance of shortenings should be maintained in better condition than at present, and that further research be made into the use of antioxidants in the manufacture of wrapping material.

Our Contemporaries

Articles published in the associated journals of the Leonard Hill Group this month include the following:

"The Construction Work for the Water Supply to the New Town of Crawley" (*Muck Shifter*).

"Cold Sterilisation," by Dr. W. Summer; "Lanolin Manufacture," by Dr. J. L. Boyle (*Manufacturing Chemist*).

"Chemical Engineering Research in Australia"; "Heat Transfer," by J. Moss (*Chemical and Process Engineering*).

A bag of stringless beans is emptied into the snipper which tops and tails them at the rate of 750 lb. an hour.

A Modern Vegetable Prepackaging Factory

The 120 blades of the bean slicing machine slice the stringless beans at the rate of 300 to 400 lb. an hour.

THE development of quick frozen and prepackaged vegetables is gaining momentum in the State of Victoria largely owing to the enterprise of a young Australian, Geoffrey Levett, who became interested in a British prepackaging vegetable factory and realised the vast Australian potential of this industry.

It was in 1949 that Mr. Levett formed the company of Pict Pty. Ltd., but nearly a year elapsed before he was ready to put its products on the market.

Preliminary experiments to decide the keeping life of a vegetable under refrigerated and non-refrigerated conditions were conducted in a small laboratory in the Melbourne suburb of Canterbury.

Installation of New Plant

Early in 1950 the company was ready to go into production at its present site at Blackburn. By the end of the year, as most of the early machinery was found inadequate to cope with production demands, more efficient and modern machinery was installed. Much of it was made and developed in the factory, the rest

Above: **The peas are cascaded from the huller, which shells 2½ tons of peas a day; they are then inspected before being prepared for the packaging department.**

Right: **Mr. and Mrs. Levett inspect the diced mixed vegetable packets going through the heat-sealing machine.**

being imported from Britain and America.

With this machinery it is now possible to shell 2½ tons of peas a day; top and tail 750 lb. of beans an hour, or French slice them at the rate of 300 to 400 lb. an hour; and dice 4 tons of carrots, parsnips, onions, turnips, or celery an hour.

Stringless Beans

When production began it was found that there were no suitable stringless beans on the market, so seed was imported from America. Stringless beans are now being grown under contract, not only in Victoria, but as far away as the northern State of Queensland, whence they are flown to ensure supplies all the year round.

Although the Australian climate makes it possible for supplies of nearly all vegetables to be available throughout the year, with the aid of quick freezing the Australian catering industry and the domestic market are assured of this supply, at prices comparable with those obtaining when the vegetables are in season.

Imperfect pieces of cauliflower are discarded before packaging.

Principles of Freeze-Drying

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Freeze-drying, or drying by sublimation, has received increased attention during the past ten years. It has been applied in the laboratory and industrially to foods, such as fruit juices and coffee; to pharmaceuticals, such as penicillin; and to medical products, such as blood plasma and serums. This process shows promise of increased applicability in the future.

IN freeze-drying, the wet material is frozen, and the ice is then sublimed, *i.e.* evaporated directly from the solid state, under a vacuum. The water vapour is removed from the apparatus and discarded, leaving the dried material as the product.

Because of the low temperatures employed in freeze-drying, the material is protected from chemical or bacteriological degradation. This makes possible a greater stability in flavour than is obtainable in any other process for the dehydration of foods. The flavour of foods which have been freeze-dried is virtually indistinguishable from that of fresh food. Chemical oxidation is minimised by the low temperature and the vacuum used. The biological activity of the material is unaffected by freeze-drying, thus, the nutritional value of foods is unimpaired.

It is sometimes thought that by operating at low temperature the loss of desirable volatile materials by evaporation is prevented. Actually this is not as important as might be suspected. While the vapour pressure of these volatile substances decreases markedly as the temperature decreases, the ratio of vapour pressure of the volatile material to that of water is usually fairly insensitive to temperature changes. It is this ratio which determines the amount of volatile matter evaporated. Only those organic substances having high molecular weights, *e.g.* possessing ten or more carbon atoms, show any decrease at all in this ratio and it is generally a small decrease.

The low temperature of the freeze-drying process ensures that chemical deterioration of the volatile substances, which give the product its flavour, is avoided. Freeze-dried products are readily soluble in water, since they emerge as a highly porous mass into which water can readily penetrate. The increased ease of solution in water thus obtained is sometimes the principal reason for using the freeze-drying technique.

Sublimation Processes

In the usual sense of the word, sublimation means the formation of a vapour directly from a solid, without passing through the liquid state. For a pure substance this process is indicated by the line AB in Fig. 1, which is a phase diagram for water, plotted on semi-log paper. The word "sublimation" is also used to represent the reverse process, *i.e.* a process in which a vapour is condensed directly to the solid state, without passing through the liquid state. An ordinary vaporisation (or distillation) process, *i.e.* one in which the solid first melts and then vaporises, is indicated by the path CD. The temperature at which the vapours form in either case is indicated by the point at which the respective dotted (constant pressure) lines intersect the vapour pressure curves, *i.e.* the "sublimation curve" or the "vaporisation curve."

It will be noted that sublimation always occurs at a lower temperature than distillation; indeed this is generally the principal advantage of sublimation. Whether a substance will normally sublime or will melt and then vaporise de-

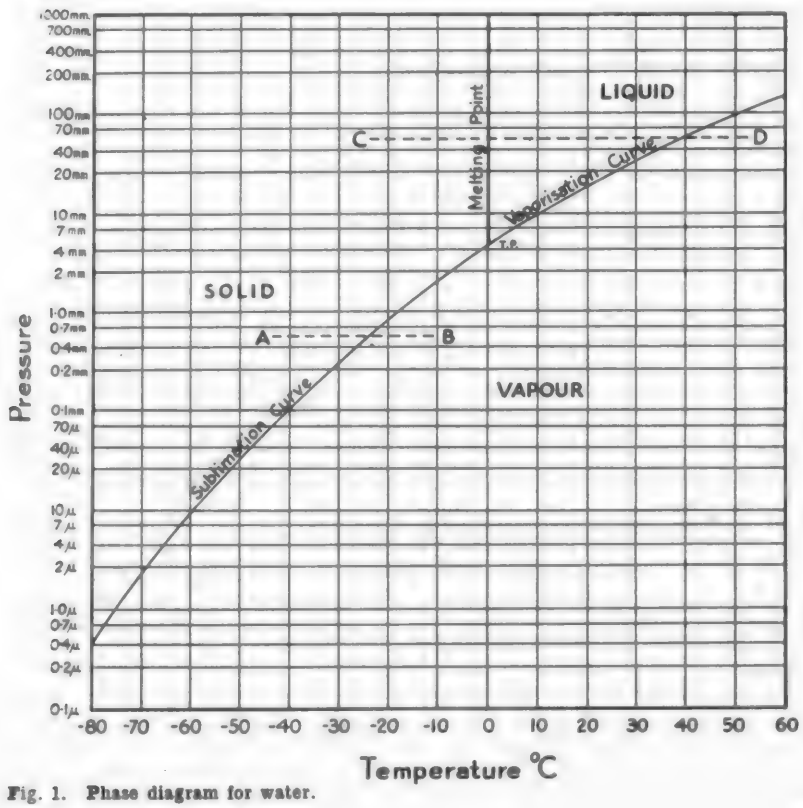

Fig. 1. Phase diagram for water.

pends on the location of the triple point, marked T.P. in Fig. 1, which is the point of intersection of the sublimation, vaporisation, and melting-point curves. It is evident that vaporisation of a solid without prior melting can be accomplished only at pressures, or partial pressures, below that of the triple point. If the triple point of a substance is above atmospheric pressure, the substance will normally sublime; an example is dry ice (carbon dioxide).

If, on the other hand, the triple point of the substance is below atmospheric pressure, as is the case for water, sublimation can be accomplished only by reducing the pressure, or the partial pressure, below atmospheric pressure. It follows, therefore, that sublimation will ordinarily require the use of vacuum, in order to reduce the pressure, or the presence of an inert gas or "entrainer," in order to reduce the partial pressure of the substance to be sublimed The former process is called "simple sublimation," while the latter is called "entrainer sublimation." In freeze-drying, simple sublimation is used exclusively.

Simple Sublimation

Simple sublimation is normally conducted in the manner indicated in Fig. 2. That is to say, the material to be sublimed is placed in a still. Heat is provided in the still during the drying process in order to vaporise the material being sublimed. The vapours are generally carried by pipeline to a condenser, which is cooled in order to condense the sublimed material. It is necessary to evacuate the air from the apparatus down to the operating pressure before the sublimation process is started. It is also necessary thereafter to continue pulling a vacuum with a pump or ejector for two reasons: (1) to remove air inleakage, and (2) to permit mass flow of the vapours from the still to the condenser.

The second of these requires further explanation. Let it be supposed that a perfectly air-tight system has been evacuated down to 1 mm. Hg and that it is proposed to sublime ice in the apparatus. If the ice is maintained in the still at

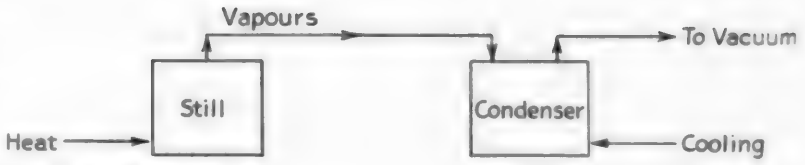

Fig. 2. Simple sublimation.

−18°C. it will exert a vapour pressure of 1 mm. Hg, which is enough to force the remaining air out of the system if the system is open to a vacuum pump or ejector. If the system is closed, however, the air will remain in it, and the total pressure will be 2 mm. The partial pressure of ice in the vapour space in the still will be 1 mm., and that of ice in the vapour space in the condenser will be zero initially and can be maintained at a value well below 1 mm. by maintaining a condenser temperature below −18°C. There will therefore be a partial pressure driving force, which will cause diffusion of water vapours from the still to the condenser, where they will condense as a solid. A sublimation process may therefore be said to be occurring. However, the rate of diffusion of a vapour through an inert stagnant gas is virtually nil where the length of diffusion path is anything greater than a mere "film."

As a practical matter, the presence of an inert gas, such as air, in a closed system would prevent the sublimation process from proceeding. If the air has been removed, the vapours can move in mass flow from the still to the condenser as fast as they are formed. For this reason, the vacuum pump must not be turned off until virtually all the air has been removed and replaced by vapours of the substance distilling. Even after this has been accomplished, continued pumping remains necessary, in order to remove air which leaks into the system during the process.

In the ordinary simple sublimation process it is extremely important that the equipment be as air-tight as possible, since increased air inleakage increases the required size of the vacuum pump or ejector and decreases the amount of sublimate condensed in the condenser.[1] In freeze-drying this is less important than usual, since the sublimed material is water and is to be discarded, rather than recovered. In fact, it is perfectly feasible to operate a freeze-drying process without any condenser at all, provided the vacuum equipment can pump out the water vapours fast enough.

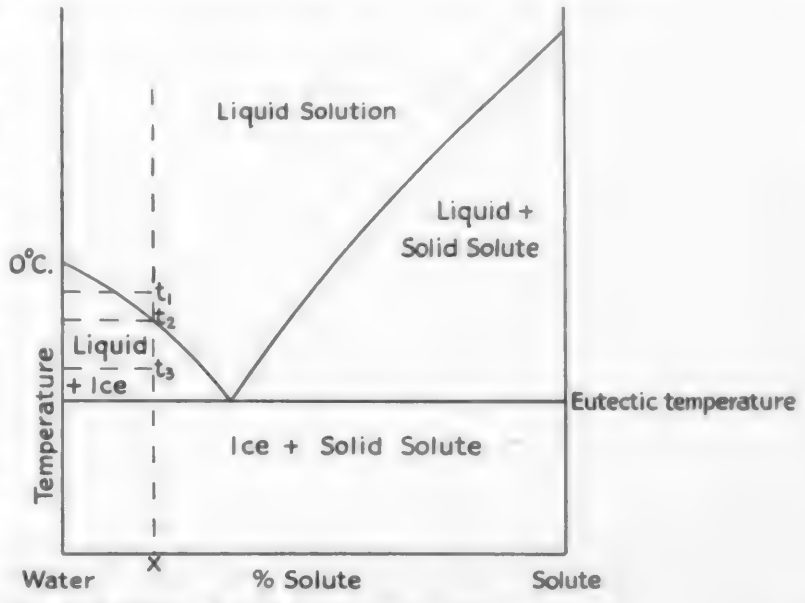

Fig. 3. Equilibrium diagram for water-solute system.

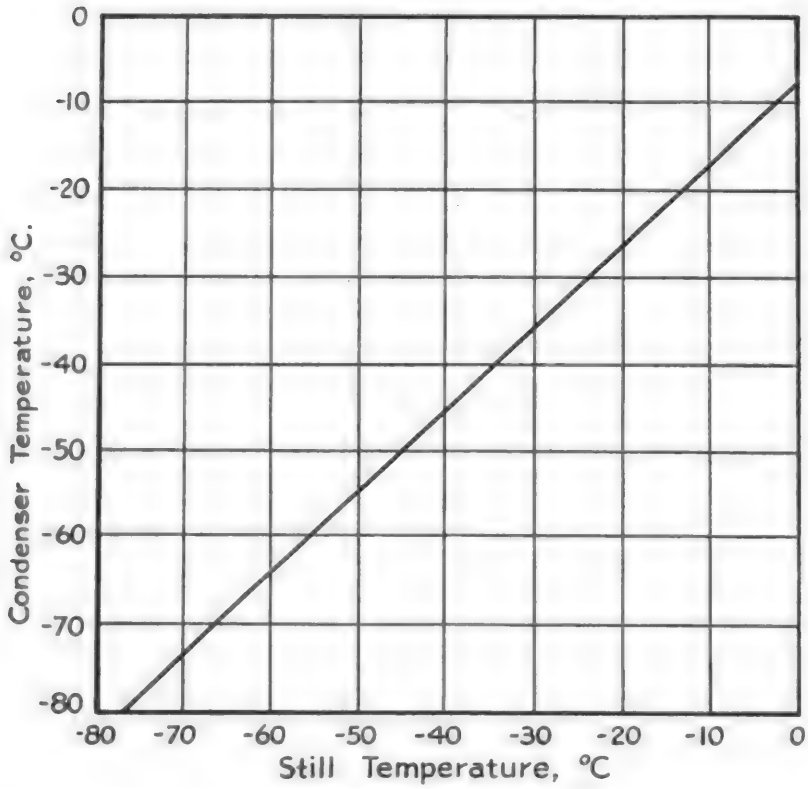

Fig. 4. Required condenser temperature for maximum vapour flow rates.

In general, the sublimation of solids greatly resembles drying, since a solid is to be heated and vapours are to be formed and removed. The difference is, however, that in sublimation no liquid material is normally present in the void spaces, so that heat transfer is slower than in drying. If this is kept in mind, satisfactory still designs for sublimation, or adaptation of existing drying equipment, are not difficult. This is especially so in the case of freeze-drying.

In freeze-drying, the material to be frozen is not generally pure water, but rather an aqueous solution of some solute in water. Assuming this solute to be miscible with liquid water and immiscible with ice, the equilibrium diagram of such a system would be as represented in Fig. 3. As indicated in this diagram, the freezing point of such an aqueous solution will be lower than the freezing point of pure water.

If a solution of the composition indicated as X in the diagram were maintained at a temperature t_1, it would be liquid instead of solid. It would be necessary to lower the temperature to t_2 before solidification would begin. At a temperature t_3, there would be some ice crystals and some liquid solution in equilibrium with each other. In order to solidify the solution completely, it is necessary to cool it to the eutectic temperature.

Thus, for freeze-drying, the temperature of the still must be at least as low as the eutectic temperature, rather than merely at o°C. If the still is maintained at a temperature such as t_1, the process will be essentially a straightforward vacuum drying process, instead of freeze-drying. This is not necessarily bad, however, since the temperature may yet be low enough to avoid deterioration of the material being dried.

An advantage of operating in the liquid state is improved heat transfer. The product obtained in this way may not, however, have the advantage of high solubility in water.

Freezing the Product

The first step in a freeze-drying process is freezing the wet material. This may be done outside or inside the drying apparatus. If it is done externally, dry ice or a refrigerating system is required. If it is done internally, freezing may be accomplished without the use of a refrigerant, the cooling being obtained by virtue of the evaporation of moisture in the product when a vacuum is applied. The latter is the method commonly employed in large scale processing. In the case of fluid materials like orange juice, for example, the simplest procedure is to pipe the juice directly into the trays of an ordinary vacuum shelf drier.

When self-freezing is employed, the full vacuum should not be put on immediately, as it may cause a considerable amount of frothing; instead a preliminary degassing period, under a partial vacuum, should be allowed. This necessarily slows down the freezing process and decreases the productivity of the drying apparatus.

In external freezing, the cost of the refrigerant may be offset to some extent by increased productivity of the drying apparatus. In addition, the rapid freezing obtainable in external freezing is advantageous in that it leads to the formation of a large number of small ice crystals; this is generally regarded as contributing to an increased surface area of the dried product, thereby increasing its rate of solution in water.[2] External freezing is commonly employed when processing on a small scale.

Removal of the Water Vapour from the Drying Chamber

As indicated above, the removal of air from the apparatus permits mass flow of water vapour from the still or drying chamber to the condenser. The water vapour must be removed from the drying chamber as fast as it is formed, if the evaporation process is not to be impeded. If the water vapour is removed from the still at a slower rate than it is formed, the pressure in it will continually increase. As may be seen from the phase diagram (Fig. 1) this necessarily increases the sublimation temperature.

The problem of removing the water vapour from the drying

chamber at the maximum possible rate may be resolved into two parts: (1) increasing the pressure driving force, and (2) decreasing the resistance to gas flow in the connecting piping.

Increasing the pressure driving force can be done only by decreasing the water vapour pressure at the condenser, or other discharge device, since the still pressure is limited by the still temperature. However, there is a limit of pressure in the condenser below which no further increase in flow rate of a gas can be obtained. This limit is determined by the "critical pressure ratio," or ratio of downstream to upstream pressure; for water vapour, the critical pressure ratio is about 0·54.

At the critical downstream pressure, the gas is flowing at the acoustic velocity (or speed of sound), and a further reduction in downstream pressure below this will not increase the flow rate any further. In fact, this will remain the same as if the downstream pressure were still critical. Thus, in freeze-drying, there is normally no necessity for reducing the condenser (or other discharge device) pressure below 54 per cent. of the operating pressure in the drying chamber or still. In Fig. 4, a plot is given of the condenser temperatures required, in order to obtain a pressure ratio of 0·54, at different still temperatures.

Further reduction in the condenser temperature is not useful, unless there is considerable air inleakage, or unless the operating pressure of the entire apparatus is in the micron range—say 20 μ or less. This latter case is exceptional.

In the event of there being a considerable amount of air inleakage, the amount of water vapour remaining uncondensed and passing to the vacuum pump will be substantial. This may interfere with the operation of the vacuum equipment, particularly if it is an oil-sealed mechanical pump. Let it be assumed that r moles of air leak into the apparatus per mole of material vaporised; the total pressure P in the condenser will then be greater than the vapour pressure P_e corresponding to the still temperature, *i.e.*

$$P = P_e \quad (1+r) \qquad (1)$$

The number of moles of vapour uncondensed per mole of air leaving the condenser is:

$$\left(\frac{\text{moles vapour uncondensed}}{\text{mole air inleakage}}\right) = \frac{P_c}{P - P_c} \qquad (2)$$

where P_e is the vapour pressure corresponding to the condenser temperature. The per cent. of vapours uncondensed is thus:

$$\% \text{ uncondensed} = \left(\frac{\text{moles vapour uncondensed}}{\text{mole air inleakage}}\right) \times \left(\frac{\text{moles air inleakage}}{\text{mole material vaporised}}\right) \cdot 100\% \qquad (3)$$

or

$$\%\text{ uncondensed} = \frac{r\left(\frac{P_c}{P_e}\right)}{(1+r) - \left(\frac{P_c}{P_e}\right)} \cdot 100\% \qquad (4)$$

It is apparent from equation (4) that as the inleakage ratio r approaches zero, the per cent. uncondensed approaches zero, and that as r increases without limit, the per cent. uncondensed increases to 100 per cent. Similarly, as $\left(\frac{P_c}{P_e}\right)$ approaches zero, the per cent. uncondensed approaches zero, and as $\left(\frac{P_c}{P_e}\right)$ approaches unity, the per cent. uncondensed increases to 100 per cent. Thus, for relatively complete condensation, low air inleakage and a relatively low condenser temperature, compared to the still temperature, are required.

Since the vapour pressure decreases rapidly with temperature, it is not necessary that the condenser temperature be very low. For example, in the case of water vapour, a condenser temperature of −40°C. with a still temperature of −20°C. gives a value of (P_c/P_e) of 0·12. In this case, the amount uncondensed should be less than 1 per cent. if the inleakage is reasonably small. It will be observed that if there were no air inleakage, the condenser temperature required (according to Fig. 4) would be −26·3° C. but that if there is substantial air inleakage, a condenser temperature of −40°C. is preferable if it is desired to condense substantially all the water vapour as ice in the condenser. If the passage of water vapours to the condensing system is not regarded as detrimental, *e.g.* where a steam ejector is employed, this factor may be ignored.

The temperature of the refrigerant itself must be lower than the condenser temperature, since there is considerable resistance to heat transfer through the solid layer of ice which builds up in the condenser. Coefficients of heat transfer in such condensers are always poor. Scraping the walls of the condenser is of some use, since it decreases the thickness of the ice film.

However, even if most of the ice is removed, the heat transfer coefficient of the condenser remains poor. A relatively large surface area is therefore required in the condenser. This has an incidental advantage, in that the thickness of the ice film is automatically minimised.

Direct Pumping

Instead of the use of a condenser to remove the water vapour and to provide the pressure driving force, direct pumping may be used. That is to say, the water vapours formed in the drying chamber may not be condensed, but may be exhausted directly by means of an ejector or a vacuum pump. In this case, the ejector or vacuum pump exhausts both air and water vapour, instead of air alone. Consequently it must have a large capacity for direct pumping.

If external freezing is practised, and the same refrigerating system may be made available for cooling the condenser, direct pumping is less likely to be used than condensing operations. Normally, it is considered good practice to remove condensable vapours, rather than allowing them to go directly to a pump or ejector.[3]

The same conditions of water vapour pressure (as shown in Fig. 4) must be maintained in direct pumping as in condensing operation, for maximum rate of removal of water vapours as they are formed.[4, 5]

Use of Desiccants

Another method of removing the water vapour and providing the pressure driving force is by means of desiccants. While either liquid or solid desiccants may be used, solid ones are generally employed in freeze-drying. These may be of the chemical type (forming a chemical hydrate, *e.g.* Drierite) or the physical type (*e.g.* silica gel or alumina). The water vapour pressure of physical adsorbents increases considerably with temperature, and since heat is liberated by the adsorption of water vapour by the desiccant, it may be required to be cooled unless used in excess. This is not normally the case with chemical desiccants, which maintain a more constant vapour pressure. It is not difficult with a desiccant to attain a vapour pressure of water of 10 microns (*i.e.* 0·001 mm. Hg).[6]

Another Problem

Apart from maintaining the proper pressure driving force by means of a condenser, direct pumping, or a desiccant, the other part of the problem of removing water vapour from the drying chamber as fast as it is formed involves minimising the resistance to flow of the water vapours from the drying chamber to the discharge point. This is governed by the ordinary requirements for the flow of gases through pipes, except in the case of sublimation in the low micron range. All that is normally required is ample sized pipes without restrictions.

For a given size of pipe, there is a maximum rate of flow that can be obtained by reducing the downstream pressure to the critical value; further reductions in pressure are ineffective. It follows, therefore, that an undersized vapour line must necessarily cause a reduction in the allowable sublimation rate, since an increase in this over the rate of water vapour removal would cause an increase in the drying chamber pressure and temperature.

In the event of there being a restriction in an otherwise satisfactory vapour line, it is possible to offset this by a further reduction in the downstream or discharge pressure, since there may be two or more "critical pressure drops" in series. It must be kept in mind that the volume of vapours to be handled is likely to be very large, because of the low pressure, so that the vapour lines may easily be undersized unless careful consideration is given to their design.

As has been pointed out above, freeze-drying in the low micron range is exceptional in some respects. In the first place, gaseous flow at high vacuum does not follow the ordinary fluid flow principles, but follows Knudsen's "molecular" flow formula, which may be written as:

$$Q=\frac{4}{3}\sqrt{2\pi}\sqrt{\frac{RT}{M}}\frac{r^3}{L}\left(P_1-P_2\right) \quad (5)$$

where Q is the volumetric flow rate (litres/sec) measured at the average pressure in the tube, R is the gas constant, T is the absolute temperature, M is the molecular weight, r is the inside radius of the tube in centimetres, L is the length of the tube in centimetres, and P_1 and P_2 are the upstream and downstream pressures in microns, respectively. There is no critical pressure in this case, the flow rate continuing to increase as the downstream pressure P_2 is decreased.

Mechanism of the Drying Process

Drying of solids occurs as a two-stage process. In the first stage, ice is sublimed from a frozen mass at low temperature. In the second stage, the last remaining moisture, which is adsorbed on the surface of the solid particles, is removed by evaporation at an elevated temperature. In the first stage, 98 to 99 per cent. of the water is normally removed by sublimation at a constant rate, the temperature for foods usually being −5 to −10°C. In the second stage, the moisture content is further reduced until it is less than 2 per cent. by weight of the product, and preferably as low as 0·5 per cent. This is necessary in order to achieve the best keeping qualities of the product. During the second stage, the drying rate steadily decreases.

It is necessary to heat the material well above the sublimation temperature in order to remove the last traces of moisture. The amount of elevation depends on the product and on the speed of drying desired. The only general rule here is that the material is taken to as high a temperature as it will stand in order to accelerate the final drying stage. This second stage is not true freeze-drying, but is essentially the conventional vacuum drying process. With orange juice, the second stage commonly takes 20 per cent. of the total drying time. During the first stage, a drying rate of the order of 1 mm. of depth per hour is common.

Heat Transfer and Water Vapour Flow

During the drying process, heat transfer and water vapour flow must occur. Heat must be transferred through the material to be dried to the surface of the ice where evaporation occurs. The vapours thus generated must then diffuse out into the vapour space and be removed by condensation or otherwise. Under differing conditions, either of these may be more "critical" than the other, as regards its effect in retarding the drying process.

If the heat transfer rate is high enough so that the evaporation rate exceeds the rate of removal of water vapour by condensation or otherwise, the drying temperature will increase. This decreases the heat transfer rate and may also increase the rate of removal of water vapour because of an increased pressure driving force; a new equilibrium is therefore established at a higher drying temperature.

On the other hand, if the heat transfer rate is so low that the rate of removal of water vapour tends to be greater than the evaporation rate, the drying temperature will decrease. This increases the heat transfer rate and may decrease the rate of removal of water because of a decreased pressure driving force; a new equilibrium is therefore established at a lower drying temperature. Thus, in a given plant, if there is difficulty in maintaining the drying chamber temperature as high as desired, then it can be said that the rate of heat

transfer is the limiting factor.

Alternatively, if difficulty arises in keeping down the drying chamber temperature, thus necessitating the reduction of the temperature of the heating medium or otherwise the reduction of the heat transfer rate, then it can be said that the rate of removal of water vapour is the limiting factor. There is no reason why the second state of affairs should exist, if the vapour lines are adequately sized, if air inleakage is minimised, and if the water vapour is being removed properly by a cooled condenser, a direct vacuum pump, or a desiccant. In the normal case, therefore, heat transfer is the limiting factor in determining the drying rate. The heat transfer rate is retarded because of the fact that conduction through a porous solid is notoriously low, in fact, porous solids are among the best thermal insulators known.

Freeze-drying Conditions

Under normal freeze-drying conditions, at pressures of 1 mm. or above, the water vapour in the vapour space of the drying chamber is for all practical purposes in equilibrium with the ice in the product being dried. That is to say, the partial pressure of water vapour in the vapour space in the drying chamber is essentially equal to the vapour pressure of ice at the drying chamber temperature. This equilibrium condition is established by the continued "evaporation" of a large number of molecules of water from the ice surface, and the continual condensation of an almost equal number of water molecules from the vapour into the ice surface.

The fraction of the molecules "evaporating" which are not recondensed, but which remain in the vapour phase and are removed as such, is very small; it is normally between one-hundredth and one-millionth. According to the kinetic theory of gases, the reason for this is that molecules leaving the surface of the ice immediately come into collision with millions of other molecules, so that most of them are reflected back into the solid surface, where they remain.

The theoretical rate of evaporation into a vacuum is given by Langmuir's equation as:

$$m = 429P' \sqrt{\frac{M}{T}} \qquad (6)$$

where m is the mass evaporated per unit area (lb. per sq. ft. per hr.), M is the molecular weight, P′ is the pressure (mm. Hg), and T is the absolute temperature (deg. K.) For ice evaporating at −20°C. the theoretical evaporation rate would be 89 lb. per sq. ft. per hour. This is roughly a thousand times the normal rate in freeze-drying.

It therefore appears that a very considerable improvement in freeze-drying rates could be obtained if molecular collisions could be avoided in the vapour space. This is done in the analogous process of molecular distillation, wherein a very high vacuum (in the low micron range) is employed, and the condenser is placed within a short distance of the heating surface, roughly within the mean free path at the operating pressure. At very low pressures, the mean free path of the molecules of a gas becomes appreciable; in the micron range it is normally several inches.

In the process of "molecular plating" of metals, a similar scheme is used, but the vapour condenses as a solid, instead of as a liquid. The process of "molecular sublimation" may also be employed in freeze-drying, with a view to increasing the rate of production. This has already been done in the laboratory[2] and in the plant.[7] It is important in this process that the condenser be so located that virtually all molecules leaving the heated surface have a straight-line short path to the condenser. Also, in order to avoid any substantial amount of re-evaporation from the condenser, it is very desirable to maintain this at a low enough temperature so that the saturated vapour pressure corresponding thereto is very small.

Bradish operated his apparatus with a heated tray at about −30°C., the condenser being a plate parallel to the tray about 6 cm. above it, and maintained at −80°C. In the plant, he used an apparatus containing five interleaved tray-condenser units for drying penicillin solutions. He reported very satisfactory results, but gave no explicit details as to the drying rate. It would seem that the "molecular sublimation" process should be investigated further, for use in freeze-drying or other sublimation processes.

Hot water, steam, and infra-red rays have been used for heating. The latter is not very satisfactory as it is expensive and does not readily penetrate the ice, or the dried layer of product. It is possible to use a relatively high temperature source of heating (*e.g.* steam at 40 lb. per sq. in. gauge pressure), so long as evaporation is proceeding at a fast rate. But when the amount of evaporative cooling decreases, it may be necessary to lower the temperature of the heating source, in order to avoid overheating the product or causing melting.

In laboratory apparatus, small glass containers are commonly placed on a manifold, and heated solely by convection from the room. This is not practical, however, in plant operations.

As the process of freeze-drying is being more and more widely applied, its principles and its applicability are becoming better understood. It is still a relatively new development, which shows continued promise for the future in many areas, including food dehydration. The important limiting factor at the present time is cost. It has been estimated that the cost of drying foods on a production scale, including fixed charges, is about 3 cents per pound of water. This is low enough to make freeze-drying attractive at least for products of relatively high value, such as orange juice and meats.[8]

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Vegetable Oils and Oilseeds

THE quantity of vegetable oils available per head of the world population is now significantly higher than pre-war. A recent review* of production and trade shows that world production of oilseed crops in 1950-51 maintained the high level reached in 1949-50, while preliminary details for 1951-52 indicate a further marked increase in production to a new record level. Prices, which reached very high levels early in 1951, have since fallen considerably and are now, in general, at or below the levels prevailing before the Korean crisis. The Commonwealth has remained an important producer and in 1951 was responsible for some 27 per cent. of world exports, a rather smaller proportion than in other recent years.

The net supplies of vegetable oils and oilseeds entering into world trade during 1951 amounted to some 3·9 million tons, in oil equivalent, and were 2 per cent. greater than in 1950 and 17 per cent. greater than in 1949. While the 1951 total was still 9 per cent. below the 1934-38 average, the supplies available to importing countries, other than the United States, were well above pre-war, notwithstanding a decline in the exportable surpluses of India and certain other important sources of supply. This is caused by a marked decline in the net imports of the United States, where domestic production of oilseed crops has increased considerably.

The Commonwealth is an important producer of most of the main oilseed crops and in post-war, as in pre-war, years has accounted for over one-fifth of world production. It is an even more important supplier of the oilseeds and oils entering international trade, normally providing some 30 per cent. of these supplies. In 1951, however, this proportion fell to 27 per cent., owing mainly to a temporary decline in shipments of groundnuts from Nigeria.

The subsequent decline in exports from India has more than offset heavier Nigerian shipments, while United Kingdom purchases are now much greater than in pre-war years. Thus, in every post-war year the Commonwealth has been a net importer, particularly of linseed, sunflower, soya bean, and cottonseed. In 1948-50 this import balance was well below the level of earlier post-war years, but it increased sharply during 1951 when Nigerian exports fell and United Kingdom net imports, measured as oil, rose to a record level of over a million tons, compared with some 650,000 tons in 1938.

It seems probable that an improvement in the Commonwealth balance will occur during 1952, since Nigerian shipments are above the level of last year, while United Kingdom restrictions on non-sterling purchases will also have their effect. *Per caput* food consumption of vegetable oils in the United Kingdom in 1951 was approximately 28 lb., in crude oil equivalent, compared with an average of 14½ lb. in 1934-38.

Commonwealth net exporting countries, other than Nigeria and India, include Ceylon, Malaya, New Guinea and Papua, Fiji and other British Pacific Islands, British East Africa, Sierra Leone, and Gambia, in each of which there have been developments in the oilseed industry since the war and, in general, some increase in production. A large part of the exports from these countries is purchased by the Ministry of Food under long-term contracts. Canada and Australia are now the only other net purchasers of more than minor importance. South Africa's imports of oils and oilseeds have fallen sharply, following the considerable increase in its own production, especially of groundnuts and sunflower.

A significant post-war development in world trade in oils and oilseeds has been the increased proportion shipped as oil, as opposed to seed, following the expansion of crushing plants in many important seed-producing countries. A consequence of the diminished supplies of seed entering into trade has been the growth of excess capacity in several Western European crushing industries, particularly in Germany. The actual weight of seed crushed in the United Kingdom in 1951 was little more than 1 million tons, compared with an average of 1½ million tons in 1934-38.

The review also contains appendices relating to the annual available supplies of vegetable oils in important consuming countries, the production of soap, margarine, and compound cooking fat and the utilisation of oils and fats in these commodities, and a section on the production and imports of whale oil. The utilisation tables for the United Kingdom show clearly the increased importance of palm and palm kernel oils in the manufacture of edible fats, while figures for the United States indicate the extent to which soya bean oil has replaced cottonseed oil.

* *Vegetable Oils and Oilseeds, 1952.* Pp. 146+xix. Published for the Commonwealth Economic Committee by H.M.S.O. Price 5s. net.

What's the Trouble?

THE man who read a medical book and found that he was suffering from every complaint except housemaid's knee, who was immortalised by Jerome K. Jerome in *Three Men in a Boat* nearly 50 years ago, still finds his counterpart today. It was therefore with a certain degree of trepidation that we started to read a book* which comprises a collection of medical questions and their answers.

For eight years a number of experts formed themselves into a Brains Trust for answering questions sent to the *B.M.J.* from all over the world and in response to many demands a selection of these has been revised for publication in its present form.

This small book has been prepared for the use of the general practitioner in his daily work, but it can be bought by the enquiring layman, who will find in it some interesting annotations on diet and nutrition, food allergy, obesity, and even the common cold.

* *Any Questions?* Pp. 240+xxviii. British Medical Association. Price 7s. 6d.

News from the Industry

FORTHCOMING EVENTS

Society of Chemical Industry

The November meetings for the Food Group of the Society of Chemical Industry are as follows:

Nov. 12. Conversazione (jointly with the Agriculture Group).

Nov. 20. "Technical Problems Associated with Microbiological Standards for Foods," by Dr. M. Ingram and others (joint meeting with the Microbiology Group).

Nov. 26. "Science, Industry, and Society," by The Right Hon. The Earl of Halsbury (joint meeting with the London Section).

The Agriculture Group of the S.C.I. have arranged the following meetings for November:

Nov. 12/13. "Ecology and the Use of Insecticides," at 10.30 a.m. at the Royal College of Science. Speakers to be announced (joint meeting of the Crop Protection Panel and the Association of Applied Biologists).

Nov. 18. "Sodium as a Plant Food," by Dr. J. J. Lehr, at 2.30 p.m. at the Royal College of Science.

■

Royal Institute of Chemistry

The following meetings are included among those arranged by the Royal Institute of Chemistry for November:

Nov. 6. "The Fischer-Tropsch Synthesis," by C. C. Hall, M.Sc., Ph.D., F.R.I.C. (with the West Ham Municipal College Chemical Society) at 6.30 p.m. at the West Ham Municipal College.

Nov. 12. A film display at 6.30 p.m. at the Norwood Technical College.

Nov. 18. "The Organic Chemist in Industry," by H. J. Barber, B.Sc., Ph.D., F.R.I.C. (with the Battersea Polytechnic Chemical Society), at 7 p.m. at Battersea Polytechnic.

Nov. 19. Annual General Meeting at 6 p.m. at University College, followed by a talk by the President of the Institute.

Nov. 24. "Application of Infra-Red Spectroscopy," by J. L. Hales, B.Sc. (with the Woolwich Polytechnic Chemical Society) at 6.45 p.m. at the Woolwich Polytechnic.

■

The Chemical Society

Two London lectures have been arranged by the Chemical Society for November, to be given at 7.30 p.m. in the rooms of the Society in Burlington House. They are:

Nov. 6. Willstätter Memorial Lecture, by Sir Robert Robinson, O.M., D.Sc., LL.D., F.R.S.

Nov. 20. Tilden Lecture, "The Chemistry of Intermolecular Compounds," by H. M. Powell, M.A., B.Sc.

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Society of Public Analysts

Among the November meetings arranged by the Society of Public Analysts and Other Analytical Chemists are the following:

Nov. 5. "Vitamin Assay," organised by the Biological Methods Group of the Society, at 7 p.m. at the Meeting Room of the Chemical Society, Burlington House.

Nov. 25. Annual General Meeting of the Physical Methods Group, at 6 p.m. at Burlington House, followed by an Ordinary Meeting of the Group on "Physical Methods of Analysis in Forensic Science," at 6.30 p.m.

Price Reductions

The basic prices of the Junior labeller, short stroke and long stroke models, manufactured by the Purdy Machinery Co., have been considerably reduced. This has been made possible by the formulation of a full production line consequent upon an ever-increasing demand for this machine. The benefit, therefore, from the resultant saving in cost is being passed on to future users. The price of the labelling parts remains as before.

■

A reduction in the price of industrial alcohol with effect from September 15 is announced by The Distillers Co., who have also issued a detailed schedule of new prices for plain British spirit which was distributed to trade users on that date.

Corresponding reductions have been made by The Methylating Co. in the prices of methylated and other denatured industrial spirits.

■

Reductions in the prices of certain organic chemicals, from September 15, are announced by British Industrial Solvents.

Supervision Aids Management

Making use of facilities provided by the Institute of Industrial Supervisors, the Works Division of Alfred Bird and Sons held a week-end conference at Ashorne Hill, Leamington Spa, on September 12, 13, and 14. One of the first of its kind to be held in Britain, the conference indicates a further recognition of supervisors as important members of the management team.

The conference was attended by 63 supervisors, representing all levels of supervision in the production, engineering, and technical departments in which 634 men and women are employed.

The company's objective was to give supervisors an understanding of the widening scope of supervision in the modern industrial organisation and to equip them to meet their responsibilities in representing management's policy to the shop floor.

In addition to addresses by members of the top management group, a number of opportunities were provided to discuss typical case studies and to practise the application of the principles of supervision expounded during the week-end by Mr. David H. Bramley, Head of the Department of Industrial Administration, at the Birmingham College of Technology.

The conference concluded with an address by the managing director, Mr. George M. Laimbeer, who itemised the company's objectives and personnel policies and replied to the many questions raised by the supervisors.

New Containers for Foodstuffs

What is believed to be the first contract ever placed by a Government Department in this country for corrugated fibreboard containers made from waterproof corrugated fibreboard has been secured by The Thompson and Norris Manufacturing Co.

Containers made from the new board, known as Corrutex, have been undergoing exhaustive tests for over 12 months, being subjected to severe climatic conditions; they have completely satisfied the Government experts. The material will stand up to a soaking in an amazing fashion for an indefinite length of time without undue weakening or tendency to disintegrate. Because of this unique quality, the containers can withstand damp from inside as well as outside. They form a suitable packaging medium for foodstuffs that have to be refrigerated and in the export field when packages are subject to wet or damp conditions and variations of temperature during transit.

Apart from their waterproof properties, containers made from Corrutex combine a lightness with a remarkable strength, the increased dry bursting strength being higher than that required under the Railway classification for the same caliper of ordinary corrugated board.

The initial supplies of containers under the contract are to be used for packing foodstuffs for the Forces. The following are results of tests carried out in the Government Laboratories, the caliper of the material being .023/.023 in.:

(*a*) Dry bursting strength (Mullen test), 526 lb. per sq. in.

(*b*) Wet bursting strength (Mullen test) after 24 hours immersion in water, 318 lb. per sq. in.

(*c*) Ply separation after 24 hours immersion in water, ¼ in.

Tennis Win for Fish Canner

Mr. C. W. Banks, chairman and managing director of British Fish Canners, with Mr. T. A. Heron, won the All England Veteran Doubles Lawn Tennis Championship at Eastbourne.

Coffee is vacuum packed by the new method.

Vacuum Packs for Foods

The successful development of vacuum packing is declared to be likely to produce a revolution in the packaging, distribution, and marketing of a wide range of manufactured food products.

It consists of a new process for the production of a material for the manufacture of a flexible pouch on which a vacuum of 29½ inches may be drawn within two seconds by means of a semi-automatic machine. This machine cuts a small window in one thickness of the material, draws air from the back through stippling, and finally seals it hermetically. The process entirely breaks away from the vacuum chamber tradition.

The material for the pack, which is transparent and is sufficiently strong to produce rectangular block packs without corner failure, can also be used for flat and irregular packs.

Lighter than some rigid packs, the Vac Pac, as it is called, provides an extensive storage life without refrigeration for many products. Cheese sent by sea to the Arctic for six months and kept for a further period of nine months at room temperature in Britain was found to be in perfect condition.

Bacon packed by this process has been kept without showing signs of any deterioration for many months longer than was expected, and experiments with cooked meats are in hand.

Although at the moment there are difficulties in packing liquids by the new technique, nuts, dates, yeast, dried fruit, and dried milk are already among those products which have been successfully packed.

A Warehouse Luncheon

When the new giant steel works was opened in Margam, South Wales, on October 7, 1,200 guests were served at the inaugural luncheon in a converted tinplate warehouse.

All equipment, staff, and food were transported by J. Lyons and Co. to South Wales for the luncheon. Staff, including 230 Nippies, travelled in special overnight trains, 18 railway containers being chartered to transport the equipment and plant needed to effect the transformation from warehouse to restaurant.

A push-button device of coloured light signals was used to control the service. From a special conning tower overlooking the restaurant, the supervisor "directed" the Nippies as they served each of the five courses, all the guests being served at the same moment.

A Lyons baker was on the spot to supervise the baking of 4,000 bread rolls, which were sent deep-frozen to the works. The rolls were newly baked when they reached the table.

Standards for Bags and Shoes

At the request of the British Paper Bag Federation, the British Standards Institution has published a standard listing the generally accepted sizes of the single ply paper bags most commonly used for packaging. Special types are not listed and in the case of powder-proof bags only limiting dimensions are given.

An interesting feature of the standard is the inclusion of the size designations generally used in the paper bag industry, which will enable users of bags to associate these designations with actual dimensions. The methods of measuring the dimensions of bags are also specified.

Another standard (1870 : 1952) has been prepared as a result of a conference at which representatives of Government departments, the Trades Union Congress, and many sections of industry expressed a desire for a British Standard for safety footwear. This standard supplements B.S. 953, "Strength tests for the protective toe-caps of footwear used for industrial purposes," and lays down minimum standards of make and construction for safety boots and shoes intended to provide both safety against blows and satisfactory wear in use. Tests for compliance with this standard should be made by a recognised testing authority.

The use of the registered Certification Mark of the B.S.I., which has been used for many years on protective toe-caps, is included in the marking requirements for each type of safety boots and shoes. The presence of this certification mark on a product is an independent guarantee that the product does in fact comply with the requirements of the standard. The mark may be applied to safety boots and shoes only by manufacturers who obtain a licence from the British Standards Institution.

Microchemical Methods

Commencing on January 10, a course of 12 lectures and appropriate practical work will be held at the L.C.C. Norwood Technical College on Saturday mornings from 9.15 a.m. to 12.30 p.m. This course is designed to survey the principal branches of chemistry in which small scale methods have been successfully applied.

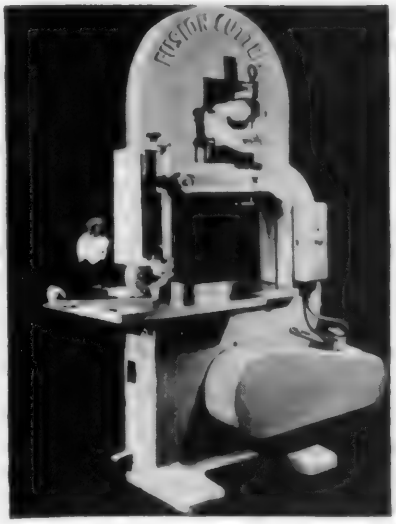
Lectures, which will be illustrated by demonstrations, will deal with scope, aims, and achievements of small scale techniques; design and construction of simple apparatus; organic and inorganic preparations on a reduced scale; simple chemical microscopy; inorganic qualitative analysis; volumetric and gravimetric analysis on a reduced scale; organic qualitative and quantitative analysis; physicochemical methods of analysis; and microtechniques for the determination of molecular weight.

In the main, apparatus either easily constructed or normally at hand will be used, as the course is of an essentially practical nature.

Application forms for admittance may be obtained from the Secretary of the College. The London fee for the course is £1.

Plastic Closures

The manufacturing activities of Scott Caps of Maidenhead have been taken over by Plastic Closures, an associated company of Metal Closures.



Cutting Stainless Steel

As a result of research into high speed cutting of ferrous metals ranging in toughness from mild steel to stainless, armour-plate, and high speed steel, George Cohen Sons and Co. have developed the Metalclad fusion cutter.

This machine operates on the principle that if a band is run at a very high speed and a steady constant pressure is exerted on the material to be cut, intense heat is generated immediately in front of the cutting edge of the band, which plasticises the material at this point, so permitting extremely rapid cutting. Since the band is moving rapidly through the air, the heat generated in it is immediately dissipated by air cooling.

After cutting, the metals have a clean edge with the appearance of having been ground, and it is possible to work to reasonably close limits such as a scribed line on profile work.

The cost of cutting most tough metals is reduced by the use of this machine, and savings in time of as much as 90 per cent. have been recorded. The rate of feed naturally depends upon the properties of the metal and also on the section and thickness. Prospective users are invited to send samples of the materials they wish to process to the company, who will carry out tests and advise them of the optimum rate of feed.

Seen at the Dairy Show

Refrigerators and homogenisers shown by G. and J. Weir at this year's Dairy Show included three compressors and two homogenisers. The ammonia compressor is a compound machine for use in conditions where the compression ratio would be excessive for a single-stage machine. This type is suitable for any application where very low temperatures are required, such as ice cream and other hardening tunnels, quick freezing plants, and ice cream freezers.

A standard single-stage ammonia compressor was also on show, together with an air-cooled, self-contained condensing unit. The compressor, condenser, and driving-motor are compactly mounted on the bedplate of these small units, which are suitable for either methyl chloride of Freon as refrigerants.

Homogeniser models included the standard size, which has a capacity of 100 to 200 gallons an hour. This model is complete with driving-motor and single-stage homogenising valve. The small capacity machines were represented by a Junior homogeniser, the capacity of which is 10 gallons an hour. The standard range of Weir homogenisers covers all capacities between 10 and 1,250 gallons an hour.

A selection of homogenising valves of the conical, serrated, and insert types was also exhibited, together with a suction and discharge valve assembly for the standard model.

*

A full range of Prestcold refrigeration equipment was exhibited, including the new chilled water milk cooler; a dairy cold room of 200 cu. ft. capacity with thermostatic control panel; a churn immersion milk cooler, four churn capacity; and farm freezers, service cabinets, frozen food cabinets and ice cream conservators, water cooled condensing units, a working milk bar, lollipop freezers, and a range of domestic models.

*

A range of dairy sterilising equipment, with special emphasis on appliances with a low electrical loading, was shown by The General Electric Co. It included a 27 cu. ft. self-contained chest and hotblock units to provide steam and hot water, and the dairy water heater which provides an inexpensive means for supplying hot water in a dairy.

In view of the present interest in crop drying, a feature was made of Aerofoil and propeller fans manufactured by Woods of Colchester combined with G.E.C. duct air heaters for in-bin and platform grain driers.

The use of the company's farrowing heater, which was also exhibited, can eliminate mortality after farrowing and greatly accelerate the fattening of pigs.

*

A working model of an entirely new type of hardening tunnel mechanism, expressly designed for dealing with cups and family packs, was featured by The S.B. Engineering Co. This new type of tunnel permits a high load concentration in a relatively small space.

The company also showed their automatic extruding table which interested users of the S. B. swing tray type hardening tunnel and all firms producing ice cream extrusions.

A third exhibit was the new lollipop freezer fitted with automatic loading and unloading gear.

*

Ice cream and cream cups and containers, waxed and foil wrappers, specimens of moistureproof containers, including metallised paper conical containers for food powders, coffee, cocoa, and similar commodities, were displayed by The Gee Manufacturing Co.

Salesmen Confer

Mr. W. Mitchell, sales director of Birds Eye, organised and presided over the recent salesmen's conference at Great Yarmouth. The company's entire sales force of 25 was present.

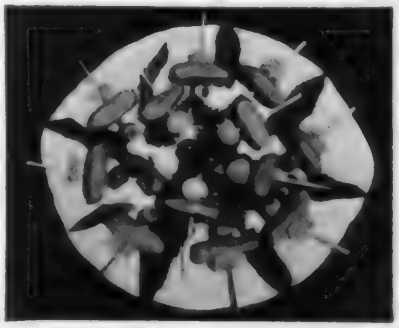
Mr. G. W. Muddiman, chairman, presided at a six-course dinner of Birds Eye foods, supported by the entire board of directors; he gave impressive figures of continued expansion of business. The frequency of salesmen's calls had been quadrupled, said Mr. Muddiman, and the number of salesmen quintupled. Quick freezing had become part of the pattern of life in the U.S.A. and was steadily making its way here.

Sausage Campaign

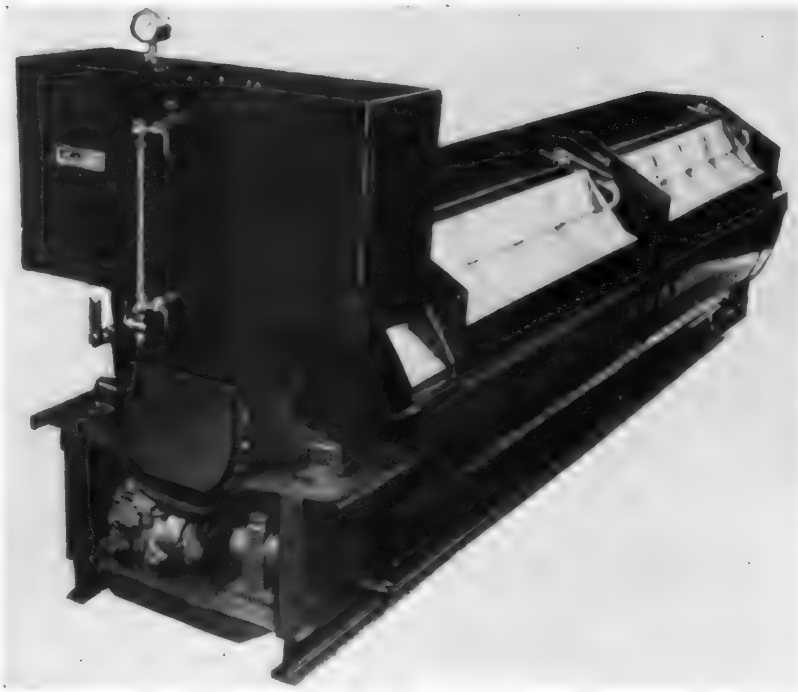
A campaign to boost the sale of sausages, organised and sponsored by the Oppenheimer Casing Co., should prove of considerable value to every sausage manufacturer and butcher who takes advantage of the publicity and advertising which the company is making available.

One of the most outstanding features of this campaign is that none of the display material will carry the name of the sponsors. It will consist mainly of full colour art posters and flashing electric signs, all of which have been specifically designed to appear as though produced exclusively for the shop or position where they are dislayed.

November will be "Chipolata Month" and the full force of the campaign will commence on November 1, by which time all display material will be available.



A new way of serving sausages.



The Flakice frozen water ribbon machine.

Ice in a New Form

Much of the ice produced nowadays is used crushed for the preservation of such foodstuffs as fish. It is also used as an admixture when mincing meat for sausage manufacture, to absorb the heat generated by the rapidly moving blades, which are not improved by contact with large pieces of ice. Ice in crushed form is also employed in various processes to control temperatures resulting from chemical reactions.

Whatever its purpose, crushed ice is a wasteful substance. It starts as blocks frozen in moulds, from which it must be thawed for release, resulting in considerable loss in weight. Then the block goes to the crusher and another considerable proportion emerges as useless slush.

Such losses are eliminated by the use of the Flakice frozen water ribbon machine, produced by York Shipley, which consists, briefly, of a refrigerated drum which revolves slowly on a horizontal shaft, and is partially submerged in fresh water. A ball-float controls this level.

As the drum revolves, ice forms upon its outer surface, generally to a thickness of ·1 to ·125 in. According to the particular model of the machine, this ice may be removed by a blade or peeled from the surface by the temporary distortion of the drum itself, which distortion is achieved by internal rollers, the drum surface in this case being flexible. Whichever method is adopted, the resulting ice emerges in ribbon form, broken into pieces of curved section and varying in size. This ice is sub-cooled, thus it is dry and will flow easily down an inclined chute; there is no waste and all the ice is usable.

A typical machine producing 10 tons of Flakice in 24 hours requires a floor area of only 64 sq. ft. and weighs about 6 tons. In consequence, it may be conveniently placed on the upper floor of a building, with an insulated storage bin below. From this bin, the ribbon ice may be drawn off as it is needed, into sacks, barrels, crates, or direct into vehicles. There is no man-handling at all.

Among the advantages claimed for this machine are that fish, vegetables, meat, and poultry cannot be harmed by sharp corners; it has a greater heat-absorbing capacity than crushed ice; calorimeter tests show that whereas the latter will absorb 126 B.Th.U's. per pound as made, Flakice will absorb 150 B.Th.U's., about 20 per cent. more. In addition, it can be used in direct contact with food. Because of its greater cooling surface, it absorbs heat more rapidly than does crushed ice, and produces a lower temperature, and it will not damage cutters or other plant.

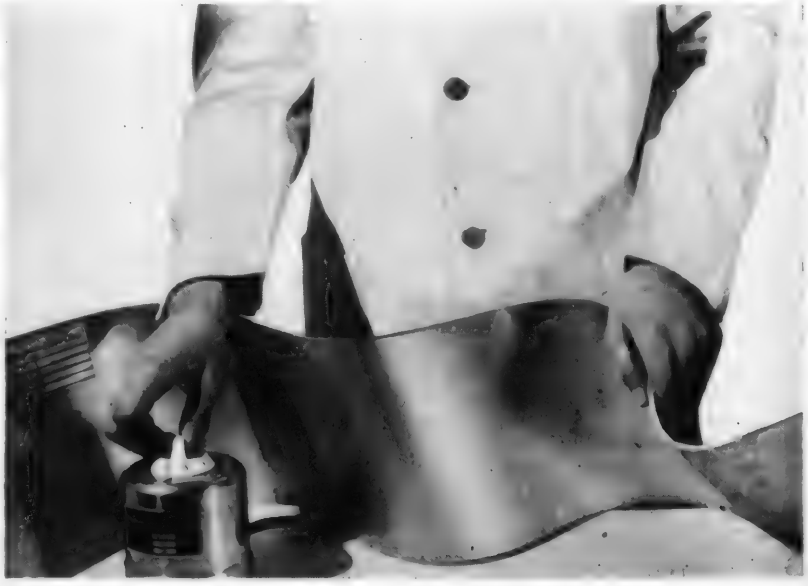
Electrothermal Rubber Sheeting

A method of applying heat in defined areas of any size has been developed and is now being marketed by Electrothermal Engineering.

Electrothermal rubber sheeting opens up a vast new field of possibilities in the application of localised heat to any area and its strength, even surface heating, high degree of flexibility, and its insulation factor against spillage, tough working, and handling conditions make it unique for a large number of applications.

The flat sheet of black rubber is electrically wired at 150, 230, or 400 watts per square foot for mains operation to radiate heat at controlled temperatures up to 200° C. sufficient for all applications of heat to flat, shaped, or curved surfaces, where the required heat input does not exceed 400 watts per square foot.

This product is supplied to requirements in virtually limitless lengths, in width from the narrowest strip up to 6 ft. and a thickness of $\frac{1}{8}$ in. Standard sizes range from 12 in. × 6 in. to 96 in. × 48 in. (heated area), but special sheets can be produced to accommodate temperature and production requirements.



Electrothermal rubber sheeting.

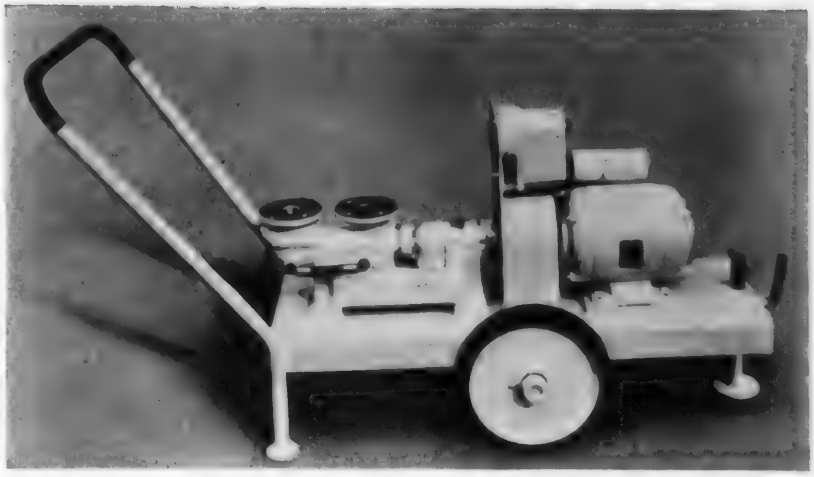
Pumps for the Brewing Industry

Pumping duties associated with beer and cider brewing and the soft drinks industry most frequently go beyond the comparatively simple operation of transferring free-flowing liquids. Beverage engineers require a pump to meet varying conditions relating to changing viscosities, temperatures, and pressures. In addition, the factors involving the difficulties of priming, suction lifts, automatic controls, and the need to avoid agitated flow cannot be disregarded.

Such equipment will be exhibited by Mono Pumps at the Brewers' Exhibition to be held from November 24 to 28. The Mono pump consists of a single rotor rolling in a fixed stator; there are no valves to adjust. The principle of operation produces a steady non-pulsating flow with self-priming ability and suction lifts up to 27 feet of water. Its efficiency is uniform over varying speeds and pressures—a feature of considerable importance for efficient filtration and when feeding water to a carbonator.

Because of its inherent characteristics, it will handle not only free-flowing liquids, but also compound fluids such as spent yeast, finings, fruit pulp, or pectin, and it is therefore extremely adaptable to the beverage industry.

The company will be displaying a selection of their cast-iron, gunmetal, and stainless steel pumps and will include a useful two-wheeled portable pump unit.



The portable stainless steel Mono pump.

Electricity for Beet Sugar

Since the beginning of the British sugar beet industry in East Anglia, electric motors have been used to drive the machinery for extracting sugar from the raw beet.

In recent years modernisation and development have required the installation of new power station and factory electrical equipment.

The Contract Department of Crompton Parkinson have carried out electrical installations at Felstead, Kings Lynn, Ipswich, and at the Bury St. Edmunds factory, which is the largest in the British Sugar Corporation. It now has a capacity of 4,500 tons of beet per 24 hour shift, extracting some 800 tons of sugar in the equivalent period, equal to about 4,000,000 rations.

The achievement of this output was assisted by the complete reorganisation of the electrical generation and distribution systems prior to the 1950-51 campaign.

The new generating plant consists of two 2,800 kVA turbo-alternator sets. The steam input at 285 lb. per sq. in. is 44.25 tons per hour. The turbine exhaust at 31 lb. per sq. in. is used for process work, for which purpose it needs to be supplemented by the addition of some 17.5 tons per hour, consisting of various engine exhausts together with some boiler steam supplied through reducing valves.

Power house switchgear, together with all high voltage and low voltage distribution switchgear, and power and lighting feeder cables, were supplied and installed by Crompton Parkinson, transformers being supplied by their associates The British Electric Transformer Co.

Fire Extinguishers for U.S.

Negotiations over the last five years have resulted in the acceptance and approval in the United States of a pressure-operated fire extinguisher manufactured by Nu-Swift. This is the first foreign-made fire extinguisher ever approved for use in the United States.

The approval of this extinguisher on behalf of the Associated Factory Mutual Fire Insurance Companies opens up a considerable dollar export field for the company.

Industrial Education

Miss Beryl Foyle, who was a member of the British Institute of Management Team which visited America in 1951 to study training for management, has been asked by the Foreign Office to visit America and Canada as next year's industrialist speaker.

Miss Foyle is joint managing director of Boxfoldia. She is chairman of the Group 2 (Midlands) Management Research Groups, a member of the Executive Council of the British Association for Commercial and Industrial Education, a member of the Joint Industrial Council of the Printing Industry, Birmingham, and chairman of the Birmingham School of Printing Advisory Committee. Among many activities in the field of education, she is a co-opted member of the City of Birmingham Education Committee, a Life Governor of Birmingham University, and a member of the University Appointments Board.

Miss Foyle will spend January and February in America, speaking on industry in Britain to business groups in industrial centres.

Selling Food Products

The hard selling techniques employed by many American food manufacturers is a part of their business which might well be emulated elsewhere. While it is true that American sales methods would be unlikely to meet with complete success in the U.K., there is behind all selling the need for co-ordination of effort and the basing of that effort on established facts, which characterise American methods.

Because they have very close affiliation with one of the more outstanding American advertising agencies, Legget Nicholson and Partners are keen to put the selling of a new food product on a more factual basis.

They will accept responsibility, from the designing of the package stage to the telling of the product's virtues on hoarding and press page; they will include plans for demonstrations, public relations work, and generally supervise everything concerned with putting the product into the shopping basket.

This overall supervision and creative work has spelt success for this agency in food and other fields.

Change of Name

The name of Glazebrooks Ltd. has now been changed to Permoglaze Ltd.

The change of title involves no alteration whatever in the management or in the policy of the company and no change has been made in the name of the holding company—Glazebrooks (Holdings) Ltd.

A Dodge delivery van for confectionery.

Commercial Transport

Eight models from their current range were exhibited by Dodge Brothers at the Commercial Motor Transport Exhibition. In addition, 12 other examples of Dodge trucks were exhibited on coachbuilders' stands in the Bodywork Section.

The main feature was the new 7 ton truck model, for export only. Other exhibits included a Diesel flat platform lorry with light alloy body, a Diesel tractor chassis with cab and Scammel automatic coupling gear, a delivery van, the interior of which has been especially fitted to accommodate full-size sweet bottles, a chassis and cab fitted with specially designed concrete agitator equipment for bulk delivery of ready mixed concrete, a Diesel hydraulic end tipper, a further delivery van with a load capacity of 450 cu. ft., and a fix-sided lorry with panelled body.

D.S.I.R. Appointments

Sir Wallace Akers, C.B.E., F.R.I.C., director of Imperial Chemical Industries, and Sir Philip Johnson, director of Hawthorn Leslie and Co. and chairman of the Parsons and Marine Engineering Turbine Research and Development Association, have been appointed members of the Advisory Council for Scientific and Industrial Research.

World Health Congress

The Right Honourable Lord Eustace Percy will be President of the Health Congress which is being organised by the Royal Sanitary Institute at Hastings from April 28 to May 1, 1953.

APPOINTMENTS

Mr. C. A. Crossle, in charge of tea and coffee buying at the Lyons factories at Greenford, has been appointed an employee-director of J. Lyons and Co.

*

Mr. R. F. Pate has been appointed production manager of the Purdy Machinery Co. in succession to Mr. F. R. Fisher.

*

At a meeting of the Board of Directors, Mr. Philip A. Singleton, acting managing director, has been appointed managing director of Monsanto Chemicals. Dr. D. W. Scott has been appointed assistant to the chairman, with particular responsibility for the co-ordination of the company's activities in the Commonwealth.

The new office to which Dr. Scott has been appointed has been created with the object of strengthening the supervision of the company's continually expanding developments, particularly within the Commonwealth.

Erections and Extensions

Plans are being proceeded with by Arthur Holland, Ltd., toffee manufacturers, for the erection of new extensions to their factory which will provide employment for an additional 110 workers. Estimated cost of the project is £78,000.

*

Plans have been prepared for the reconstruction of their factory at Coppergate, York, by M. A. Craven and Sons.

BOOKLETS RECEIVED

Some of the more important aspects of filter paper and cellulose powder chromatography are described in a recent publication of H. Reeve Angel and Co.

*

In celebration of their fiftieth anniversary, the Viscose Development Company have issued an illustrated brochure containing details of the company's history and background.

*

A new folder containing suggestions for the reduction of loss and the prevention of waste has recently been issued by Thames Board Mills under the title "Making the most of Fiberite Packing Cases."

*

Increased production and modern manufacturing methods have enabled Electropower Gears to reduce their prices by 7½ per cent. A brief but detailed description of the company's present range of manufacture is contained in a new catalogue recently published.

*

The story of the old-established and progressive family business of Carter's of Coleford has been attractively and pictorially presented in a recently published booklet. Three aspects of the Carter enterprise are presented: their impressive record in scientific research and development; the establishment of a model post-war factory in the Forest of Dean; and the company's relationship with fruit growers all over the country and the methods they have developed for dealing with these seasonable and perishable products.

*

In May, 1944, the Conference of Advisory Entomologists and the Pests and Diseases Committee of the Association of Applied Biologists set up a joint sub-committee to prepare a list of common names of British plant pests, the list to include insect and related pests of domestic animals and of stored products and timber. Part I of the list, published in 1947, dealt with slugs and snails, eelworms, beetles, flies, sawflies, wasps, and related insects. In Part II, which has recently been published, the sub-committee have dealt with lice, thrips, plant bugs, aphids and scale insects, butterflies and moths, fleas, and mites and ticks. The cost of the Lists is 2s. and 3s. respectively and they may be obtained from the Entomology Department of the Rothamsted Experimental Station.

U.K. Raspberries for U.S.A.

The trial consignment of 450 tons of deep frozen raspberries sent to the U.S.A. from Scotland has proved entirely satisfactory and encourages the hope that a market can be developed there next year.

COMPANY NEWS

Lovell and Christmas

After 12 years without a change in the 6 per cent. dividend the Lovell and Christmas distribution has now been raised to 8 per cent. of which the additional 2 per cent. is in the form of a bonus.

George Cohen Sons and Co.

At the 28th annual general meeting of George Cohen Sons and Co., the Board recommended a final dividend of 18 per cent. on the Ordinary Stock, making a total for the year of 26 per cent. In his statement, the chairman, Mr. C. M. Cohen, paid a tribute to the skill, enterprise, and loyalty of the managements, staffs, and workpeople of the Group and complimented them upon handling a record volume of business, the turnover being some £3 m. greater than that of last year, while profit at £1,826,000 was the highest in the long history of the undertaking.

Scribbans-Kemp

The 25th annual general meeting of Scribbans-Kemp was held on October 2 in London, Mr. H. Oliver-King (chairman and managing director) presiding.

The following is an extract from his circulated statement:

The profit before deducting £828,873 for taxation amounts to £1,378,222, as against £1,394,704 last year, a result not unsatisfactory in view of the complex conditions operating in the food trades of this country.

Following upon my review of last year, the various costs incurred in operating our businesses continued to rise sharply, particularly in regard to packaging and transport, both of which caused us some considerable anxiety; but these difficulties were overshadowed when, owing to economic conditions, most of the food industries were faced by a severe reduction in fats and sugar. These shortages had been made up by various imported materials from all over the globe, and it was an additional blow when, in November, these imports also were severely cut. While the turnover of the Group is some 20 per cent. over that for the year ended March, 1951, the net profit is about 1 per cent. down. Shareholders may think that in view of the circumstances it is not an unreasonable result, bearing in mind the high cost in materials and services for each extra pound sterling of turnover.

During last year some recession of the cake trade was noticeable between the months of May and September, an incidence which recurs this year in a somewhat less marked degree. Last year I ventured to warn shareholders that they must not expect to maintain the same profits during the coming years, and while in the year under review the Group has made a reasonably good showing as regards profit, it must be expected that with the very large cuts in raw materials some fall in turnover is likely, which will have its inevitable effect on profit.

Looking to the future, the fate of your Group of Companies will follow very much the economic pattern of the nation: some of the difficulties, such as the scarcity of raw materials, at the moment seem intractable, but there are great reserves of strength in your Group, as indeed there are in the nation, and your Board has confidence that the technical abilities and enthusiasm of our staffs will see us through future difficulties, whatsoever these may be.

The report was adopted and a total distribution of 8 per cent. by dividend and a special bonus of 2 per cent. were approved.

OBITER DICTA

● What are kippers? — *Mr. Andrei Gromyko, the Soviet Ambassador.*

● Washing socks is more exhausting than peeling potatoes. —"*Daily Express.*"

● If I feel lazy and want to stay in bed, I bestir myself and bake a cake.—*Marlene Dietrich.*

● Between the scientist and the bureaucrat, eating has lost much of its pleasure and nearly all of its taste.—*Prof. W. Wardlaw.*

● My wife ordered me out of town for a holiday because I was despoiling my pictures and eating my children.—*Simon Elwes, portrait painter.*

● Free oysters at midday on Sundays are off now at the Green Dragon, High Street, Croydon. Someone stole the cruet last week. — "*Sunday Dispatch.*"

● French labour unions want an item to be dropped from the cost of living index and replaced by cauliflowers. The item is tennis balls.—"*Birmingham Post.*"

● I have had more satisfaction out of making a good steamed pudding than in any speech I have ever made from the Front Bench of the House of Commons.—*Miss Florence Horsbrugh.*

● If the United Nations staff alone drank all the liquor they are buying they would be drunk from morning to night all the year round.—*Mr. Joseph Matzner, publisher of the liquor dealers' newspaper.*

● A boy of 14 called Kipper was mentioned in an assault case brought by Mrs. Winifred Fish at Woking. The chairman: "He is a member of the Fish family, I presume?" "That's correct," replied the witness.—"*Sunday Dispatch.*"

● What with this old cow beef and great-great grandparents from the Welsh hills it is a wonder the National Health Service is not bankrupt. When I was a boy only the poor ate imported meat. Nowadays New Zealand lamb is something to get excited about like a day at the seaside or a Cup Final ticket. — *Mr. Stanley Evans*, M.P.

Glaxo Laboratories

Subject to completion of audit, Glaxo Laboratories announce that the profits of the Group for the year ended June 30, 1952, amounted to £1,585,000 after providing for all charges including £1,775,000 for taxation.

The Directors propose to recommend a final dividend of 20 per cent. on the Ordinary Stock, requiring £83,616 after income tax, payable on December 6, 1952, leaving £311,000 to be carried forward.

Last year a second interim and a final dividend were paid, absorbing £62,712 after income tax.

H. J. Heinz Co.

A 32 per cent. increase in the value of overseas sales compared with the previous year was announced in the chairman's statement presented at the 36th annual general meeting of H. J. Heinz Co. It was also stated that although the food processing industry was experiencing the results of the tightness of money, there was still an unsatisfied consumer demand for several of the company's major lines. This was one reason why the outlook was satisfactory, provided some improvement in the tinplate situation developed and no new supply difficulties were encountered.

Four interim dividends were declared on the Ordinary shares, 10 per cent. in July and October, 1951, and January, 1952, and 5 per cent. in April, 1952. As no final dividend was proposed, this made a total of 35 per cent. for the year, compared with 34 per cent. in the previous year.

Piping Jelly

"How to Use Piping Jelly" is the subject of a booklet published by Lenderink and Co.

World Food News

FORTHCOMING EVENTS

Utrecht Fair

The 60th Utrecht International Industries Fair is to be held from March 17 to 26. The available space is to be increased by the use of a new hall.

Ireland Expands Freezing Plants

Irish frozen meat exports, which in the first six months of this year totalled 4,636 tons, are to be doubled by means of a new, speedy refrigeration system evolved by the Irish Meat Exporters Committee. An all-year-round outward trade will also be made possible. The dead meat trade has been gradually taking precedence over meat exported on the hoof. Last year canned stewed steak exports to Britain were doubled, dressed meat exports trebled, and canned beef exports increased by 60 per cent.

There were six freezing plants in Ireland in April, 1950; by September, 1952, this number had increased to 80 modern factories. Another factory is now in the course of erection at which 400 workers will be employed. In all, 200,000 cattle a year can be processed at Ireland's existing plants.

From Dublin centres the product is brought to the quayside in insulated containers and transferred to the ships' refrigerators by insulated trolleys on conveyor belts. The chill system continues all the way to Smithfield Market, London. The importance of the trade is emphasised by the number of ships being fitted out to cater for it, each capable of carrying 200 ton cargoes, and the fact that the Irish transport company is to triple its fleet of special lorries designed for the trade.

The Irish Government is giving every help. It means more work for people at present unemployed as much additional labour will be required for slaughtering, processing the offal into sausage casings, processing the hides, and the manufacture of glandular extracts of meal for feedingstuffs from the blood and bone of the animals.

The new industry's dollar earning capacity is particularly impressive. In 1951 the U.S. paid over $5,000,000 (£1,650,000) for 13,240,000 lb. of Irish frozen beef. *Foreign Agriculture*, the official organ of the U.S. Department of Agriculture, has described the Irish standard of production, packing, and handling as very high.

World Meat Production

World meat production, while increasing, is failing to keep pace with population increases. In spite of the increase in supplies, the overall *per capita* consumption in 1951 was little different from that of 1950 and considerably less than in pre-war years in most countries.

Increased population in all countries, decreased export surpluses in traditional exporting countries, and decreased production in many European countries have been the major factors in holding back the *per capita* consumption of meat.

With populations continuing to increase and no immediate prospects of significant increases in meat supplies, little improvement could be expected soon in the average person's consumption of meat in most countries of the world.

The *per capita* consumption of meat last year in countries for which information could be obtained varied from an average of 23 lb. in Greece to 235 in Uruguay. The average in the United States was 138 lb. and in the United Kingdom 88 lb.

Change of Address

Comm. Ing. Franco Emanuele, director of the Experimental Station of the Food Preservation Industry, has left Parma for Rome, where his new address is Via Civinini 79.

Antioxidants and Sweet Manufacture

A memorandum has been issued by the Universal Oil Products Company relating to the addition of antioxidants in the manufacture of sugar confectionery in which it is stated that the ideal methods are either to obtain the antioxidant incorporated in the flavour extract or replace ordinary salt with an antioxidant salt. The statement has been published as some manufacturers have been incorporating additional quantities of antioxidant to their products in the mistaken belief that a greater protection against rancidity would result.

Canning School Opened

The Norwegian Canning School at Stavanger has been opened by King Haakon. It is said to be the only school in the world exclusively concerned with the training of personnel for the canning industry.

The chairman of the building committee, Chr. W. Bjelland, said at the opening that the aim of the school would be primarily to combine theoretical instruction with practical work. The pupils would be taught the most up-to-date developments in the industry, both with regard to machines and production methods. Great emphasis would be put on rational factory management and production methods.

Refrigerated Transport

A fleet of sixty refrigerated units is operated by Barnes Food Express for the transportation of frozen foods, dairy products, and similar items of foodstuffs. Each unit is insulated with six inches of ultra-light fibre glass all round, and equipped with heavy duty Thermo King units with five ton refrigerant capacity compressors.

Interior of the refrigerated trailer for the transport of foodstuffs.

Bakery Sanitation Standards

Two further U.S. standards have been issued in the series covering the various categories of bakery machinery and equipment. These deal with dough troughs and mechanical proofers.

More Cold Storage for Hungary

Two new cold storage plants will be opened in Hungary by the end of this year. They are part of a plan to add, by the end of 1954, a further 20,000 tons capacity to existing plant.

A four-storey plant now under construction at Györ will store meat, poultry, game, dairy products, and fruit from surrounding agricultural areas.

The second plant, being built at Debrecen, will be supplied with meat from the large Debrecen abattoir, whose poultry department is fitted to kill, pluck, and clean 20,000 birds a day.

World Grain Record

World bread grain production in 1952-53 will probably reach an all-time high record, according to the U.S. Department of Agriculture's first estimate for the new season. The Department tentatively forecasts the output at about 258 million short tons—10 million tons above the previous record crop of 248 million tons in 1938-39.

Argentine Exports of Animal Fats

Argentina's exports of animal fats and oils continued at sharply reduced levels during the first half of 1952, according to the U.S. Agricultural Department's Office of Foreign Agricultural Relations.

During the first six months of this year they totalled only 1,471 short tons against comparable exports of 9,534 and 45,877 tons in 1951 and 1950 respectively.

The low level of animal fats and oil exports in the last two years is primarily the result of the virtual depletion of stocks in 1950 because of unusually heavy shipments in the first 10 months of that year. Another important factor is that domestic demand is currently running about equal to domestic production.

Of the exports during the first six months of this year, 1,181 tons were lard, 237 tons were premier jus, and 33 tons were tallow. Lard shipments went principally to Italy, followed by Peru and Finland. The premier jus went to Britain and the Netherlands, while the tallow went to Chile.

In August, 1952, the Argentine Trade Promotion Institute (IAPI) agreed to sell to the Brazilian Government 1,000 metric tons of edible lard at a price equivalent to 4.86 Argentine pesos per kilogram. According to trade sources, a further agreement has been made with Chile for shipment of between 500 and 550 metric tons of lard at a price of 4.75 pesos.

News from the Ministries

Dried Apples and Pears

The Dried Fruits Order, 1951, has been amended so as to free dried apples and pears from price control with effect from September 21, 1952.

The Ministry has no imported dried apples or pears available for distribution at present and it is hoped that the removal of price control will help the British dehydration industry to develop the drying of apples and pears on a commercial scale.

Imports of Linseed and Linseed Oil

The buying on Government account of linseed and linseed oil from overseas has now ended, and private imports from any source will be permitted as from January 1, 1953. For the time being, licences will be granted for the import of 1 ton of linseed oil or 3 tons of linseed for every 3 tons of linseed oil purchased by the applicant from the Ministry of Food after September 6, 1952. The ratio of permitted imports to purchases from the Ministry of Food will be reviewed from time to time in the light of the rate of disposal of Ministry stocks.

Applications on this basis should be made separately for linseed and linseed oil on Form ILB/A (Revised) and should be sent to the Board of Trade, through the Ministry of Food (Oils and Fats Division), London Road, Stanmore, Middlesex.

The licences will be available for imports from any country from January 1 to June 30, 1953. Importers will be asked to submit periodical returns showing the quantities of linseed and linseed oil imported against the licences issued to them.

Food Office Organisation

Experiments to test the possibility of other Departments with conveniently placed local offices carrying out the duties of some of the smaller food offices on an agency basis were inaugurated in February last. Subsequently, on April 18, details were published of a pilot scheme to operate in 33 local offices of the Ministry of Labour and National Service and 18 local offices of the Ministry of National Insurance.

This experiment has been successful and the Minister of Food, in collaboration with his colleagues, has arranged for the experiment to be extended in stages to some 500 food offices throughout Great Britain, beginning in October and continuing over a period of six months. Many of the offices concerned are those which, because of the relatively small volume of business they now transact, would, but for the agency arrangement, open part-time only or close altogether in order to save expense. The extension of the system of working through the offices of other Departments on an agency basis will result in a saving of money and, in many instances, in the provision of a better service to the public than would otherwise be economically possible.

New Zealand Meat Negotiations

Following discussions with the New Zealand Minister of Agriculture and Marketing, Mr. K. Holyoake, and Mr. J. Ormond, the chairman of the New Zealand Meat Producers' Board, agreement has been reached on the prices to be paid by the United Kingdom for meat from New Zealand in the season beginning October 1, 1952.

Because of rising costs of production in New Zealand, increases averaging 12½ per cent. on the current prices will be paid. The detailed price schedules have yet to be worked out.

Under the seven-year Agreement with New Zealand which runs to September 30, 1955, there is at present a limitation of 7½ per cent. on price changes in any year. This clause has been found for the second year in succession to operate against the object of the Agreement which is to secure a steadily increasing production of meat for export from New Zealand, who are already by far our biggest suppliers. It has therefore been further agreed that the clause should be amended to permit of price variations of up to 10 per cent. by reference to changes in prices paid by the United Kingdom elsewhere, and if either party desires a greater variation than this, regard will be had to changes in New Zealand conditions and costs of production.

Potato Sacks

The deposit payable on Ministry of Food sacks in which potatoes are loaded will be reduced forthwith from 2s. 6d. to 1s. a sack. As at present, the new deposit charge will be credited to traders on the return of the empty sacks to the Ministry Sack Depot.

Traders holding Ministry of Food sacks on which a deposit of 2s. 6d. each was paid during the 1951-52 season should return them as soon as possible. No credits at the 2s. 6d. deposit rate will be given after November 15, 1952.

Home-grown Linseed

The Ministry of Food will no longer buy home-grown linseed after March 31, 1953, when its undertaking in respect of this year's crop expires. Until then, the Ministry will continue to pay £65 a ton *ex* farm for linseed of 90 per cent. purity with appropriate adjustments for seed of greater or less purity. As at present, there will be no obligation on farmers to offer their linseed to the Ministry during this period. They are free to offer it direct to the seed crushers for crushing or to dispose of it in any other way they wish.

Tea is Freed

The rationing and price control of tea ended on October 5, 1952.

This has been made possible by the steady improvement in tea production, especially in the Commonwealth countries of India, Pakistan, and Ceylon from which the United Kingdom obtains the bulk of its tea.

In recent weeks the retail prices of many blends of tea have fallen below their controlled prices. It is now possible therefore to remove price control without risk of a shortage of supplies which would lead to a rise in prices, and this will enable the trade to provide the consumer with the greatest possible choice of blends.

All other restrictions on the sale of tea by wholesale and by retail have also been lifted.

The import arrangements for tea have been relaxed. About 95 per cent. of the tea coming to this country will be allowed in on Open General Licence.

Standards for Coffee Mixtures

The Food Standards (Coffee Mixtures) Order, 1952, which prescribes a minimum coffee content for coffee and chicory mixtures and for coffee with fig flavour or fig seasoning, came into force on September 21, 1952, for all sales.

The minimum coffee contents prescribed are 51 per cent. by weight of pure coffee for coffee and chicory mixtures, and 85 per cent. for coffee and fig mixtures. The minimum coffee content prescribed for coffee and chicory mixtures is the same as that maintained in the Coffee Order, 1951, until that Order was revoked on August 20, 1952. The standard prescribed for coffee and fig mixtures is introduced for the first time.

The new Order also provides that coffee and chicory mixtures shall contain only coffee and chicory and that coffee and fig mixtures shall contain only coffee and figs.

In making these standards, the Minister has had regard to the recommendations of the Food Standards Committee and to the representations which were received following the publication of the Committee's proposals in May, 1951.

Imports of Jamaica Bananas

The delegation from Jamaica, which has been visiting Britain for discussions with the shipping and marketing companies concerned in the banana trade about possible arrangements for the transport of Jamaica bananas and their marketing in the United Kingdom, has now returned for further consultations with the Jamaica Government and banana interests in Jamaica.

At the present time the Jamaica Government has a long term contract with the Ministry of Food under which the Ministry has undertaken to purchase 85 per cent. of Jamaica's exportable surplus of bananas or more at seller's option until the end of 1954.

Food Imports

Two Orders have been made by the Board of Trade, one revoking the Open General Licence for imports of cooked and uncooked meat products, and the other revoking or amending the Open General Licence for imports of a number of manufactured goods containing sugar.

As imports from Western Europe and many other countries of most of the goods are already subject to licensing control, these measures will in the main affect imports from the sterling area. The opportunity has, however, been taken to make certain amendments consequential to import restrictions already announced on canned meat and canned vegetables from Western Europe and other countries.

In the case of the sugar products, control of imports is intended to safeguard United Kingdom supplies of raw sugar under the Commonwealth Sugar Agreement. In the case of the uncooked meats, control is intended to check the trade in these products which might otherwise reduce supplies of carcass meat.

Corn Sales

The 1952 edition of "A Farmer's Guide to the Sale of Corn" is now available. It provides an easy reference to the provisions of the current Orders relating to the production, storage, use, and disposal of home-grown cereals. The handbook is therefore likely to be useful to farmers and merchants alike.

Copies may be obtained, free of charge, on application to the Ministry of Agriculture and Fisheries.

Wheat from Canada

The United Kingdom is to purchase 115 million bushels of wheat, or wheat in the form of flour, from Canada under the terms of the International Wheat Agreement, for registration in 1952-53. The memorandum of agreement between the United Kingdom Ministry of Food and the Canadian Wheat Board provides for the sale and purchase of the wheat and flour and also for the general shipping arrangements for the crop year 1952-53 and technical matters relating to the wheat trade of the United Kingdom and Canada.

Frozen Fruits and Vegetables

The tables below show the quantities of fruit and vegetables quick frozen during 1951 by 34 stations known to have been operating in the United Kingdom in that year. The quantity of sugar used with the fruit is shown as a percentage of the output of the finished product.

Variety	*Output (tons net weight including sugar or sugar/syrup)*	*Average use of sugar percentage (by weight of output)*
Apples and apple purée	241	17
Blackberries	41	21
Blackcurrants and blackcurrant purée	108	22
Cherries	17	18
Gooseberries	61	21
Plums, damsons, and greengages	101	12
Raspberries, raspberry purée, and loganberries	293	20
Strawberries and strawberry purée	813	25
Fruit salad and mixed fruits	86	19
Others (including peaches, bilberries, rhubarb, etc.)	200	Various
Total	1,961*	429 tons
Total ouptut in 1950	1,280	286 tons

* Of which 69 tons were packed without sugar.

Variety	*Tons (net weight)*
Broad beans	24
Green beans	665
Brussels sprouts	135
Cabbage	65
Cauliflower and broccoli	115
Peas	5,282
Others (including spinach, carrots, asparagus, etc.)	220
Total	6,506
Total output in 1950	6,800

Information and Advice

This Service is available for subscribers to FOOD MANUFACTURE. Postal replies will be sent if a stamped, addressed envelope is enclosed with enquiries.

Citric Acid

B.5989. *Could you give me some information on the preparation of citric acid for use in the food industry?* (Surrey)

Citric acid is produced by the action of *Aspergillus niger* on sugars, or processed from cull lemons which are sound and free from mould. In the latter case the juice is expressed from the fresh fruit, which has been previously macerated to facilitate pressing, the resultant liquid containing about 4 per cent. citric acid. As the fresh juice is difficult to filter, owing to the presence of pectins and gums, it is fermented to break down the latter. Although very little citric acid is lost during the actual fermentation process, film yeasts grow on prolonged standing and cause a rapid loss in acid.

The fermented juice is mixed with a little infusorial earth and boiled. The earth is added to promote quick sedimentation. The hot liquor is filtered, and the filtrate treated with hydrated lime sufficient to neutralise approximately 90 per cent. of the total acidity of the juice. The remaining 10 per cent. acid is neutralised with calcium carbonate. If the neutralisation process were carried out by means of hydrated lime alone, pectic substances and gums would be precipitated, the colour darkened, and the colour of the final crystals affected. The next stage is the recovery of the insoluble calcium citrate formed, and as this citrate is more insoluble at high temperatures, the filtration is carried out at the highest possible temperature.

Sulphuric acid 66° Baumé is mixed with the citrate to recover the citric acid, which is filtered off from the insoluble calcium sulphate formed. The citric acid solution is concentrated to 39° Baumé and allowed to crystallise.

In the process of purification, the crude crystals are redissolved and all metallic and other impurities removed by various methods to render the citric acid suitable for use in the food industry.

Canned Vienna Sausage

B.5992. *Could you please furnish us with a recipe for Vienna sausage for canning?* (S.W. Africa)

The basis can be about 60 per cent. of beef to 40 per cent. of pork, to which is added during the chopping 10 to 20 lb. of cracked ice or iced water, depending on the type of meat. A suitable spice mixture per 100 lb. batch is:

	oz.
Ground white pepper	5
Ground coriander	2
Ground nutmeg	2
Sugar	7

For curing, the following mixture may be used:

Salt	3 lb.
Sodium nitrate	2 oz.
Sodium nitrite	¼ oz.
Sugar	6 oz.

With the object of reducing handling to a minimum, the so-called "emulsion cure" might be employed, the fresh beef being broken down in a mincer and placed in a bowl-cutter, the pork curing ingredients and spices added. After mixing, the product is filled into deep casings and held at about 40°F. for about 12 hours to mature. This is followed by smoking and cooking.

Glacé Cherries

B.6036. *Could you please provide me with a method for the production of glacé cherries?* (London)

Cherries to be processed have usually been preserved with sulphur dioxide. On arrival at the factory, the fruit is drained from the liquor and washed with running water for at least 24 hours to remove most of the preservative. The fruit is then transferred to a large wooden vat fitted with a steam coil, with sufficient water to cover it and allow for its free movement, and a perforated wooden disc is placed on the surface to keep it under the level of the water. Boiling is done in several changes of water until the fruit is tender, this taking from one to four hours. The surface is repeatedly skimmed to prevent the scum from discolouring the fruit. The liquor is then cooled slowly by adding cold water and the fruit is left to stand for 24 hours to leach out the remainder of the sulphur dioxide.

The now tender cherries in lots of 112 to 124 lb. are drained, transferred to wooden vats fitted with drain cocks, and covered with cold sugar syrup at 20° Baumé, containing 0.02 to 0.05 per cent. erythrosine or Ponceau 3R, according to the shade required. Alternatively, a mixture of the two dyes may be used.

The cherries are allowed to stand in this syrup for 24 hours, then skimmed, and sufficient sugar-corn syrup solution, made up of equal proportions of each raw material, is added to increase the density of the syrup by 2° Baumé. The addition of the corn syrup prevents the overdrying and increases the final transparency of the fruit. The process is repeated on alternate days until the syrup contains 75 per cent. soluble solids when tested by refractometer. On the last day the cherries may be boiled in the syrup, allowed to stand for 48 hours, and finally drained on sieves for not less than 24 hours. They are then sorted into three grades: perfect cherry; badly split, discoloured, and misshapes; and debris cherries. The drained cherries should show an increase of 10 per cent. in weight.

Information Supplied

The Enquiry Service has dealt with requests for the names of manufacturers and suppliers of plant, machinery, and materials, and also general information as follows:

B.5941. *Bacon and ham curing and vinegar plant.* (British Guiana)
B.5942. *Personnel management.* (Australia)
B.5943. *Continuous driers.* (London)
B.5947. *Copper tubing.* (South Africa)
B.5955. *Oatcakes and muffins.* (Yorks.)
B.5957. *Biscuits.* (Lancs.)
B.5959. *Lecithin and lecithin emulsions.* (N. Ireland)
B.5960. *Plant for vinegar, wine, and industrial alcohol.* (U.S.A.)
B.5961. *Apple glucose.* (Australia)
B.5963. *Citrus fruit.* (Australia)
B.5964. *Bromo acetic acid.* (Germany)
B.5965. *Soup powders.* (Australia)
B.5968. *Lobster and crabmeat.* (Ireland)
B.5969. *Oils and fats regulations.* (Devon)
B.5970. *Preservatives.* (London)
B.5971. *Packing and filling equipment.* (New Zealand)
B.5972. *Sweet biscuits.* (London)
B.5973. *Metal vacuum caps.* (Lancs.)
B.5975. *Plastic liner for drums.* (Australia)

Recent Patents

679,509. FISCHL, F.: Coffee makers of the pressure type.
679,310. SEVILLE, J. R.: Apparatus for delivering measured quantities of liquid for dough-making and the like.
679,436. BIRD AND SONS, A.: Methods of colouring starches, finely divided cereal flour or the like starch - containing materials.
677,906. DOLBY, G. R. A.: Apparatus for drying or dehydrating vegetable substances.
677,915. MARSHALL'S TEA MACHINERY CO., LTD., and RIDLER, W. F. A.: Tray or slat intended to form part of a chain type conveyor.
677,933. HISCOCK, P. E.: Egg dipping machines.
678,054. AUTOLEX, LTD.: Methods of packing nested baking cases for cakes and similar fragile lightweight hollowware.
678,116. BAKER PERKINS, LTD.: Rotary filter presses.
679,727. BRITISH CELLOPHANE, LTD.: Manufacture of moistureproof, heat-sealable sheet wrapping materials.
679,781. KLEIJN, A.: Treatment of flour from cereals, especially wheat flour.
679,981. ETUDES ET TECHNIQUES NOUVELLES: Container for the transport in bulk of powdery or granular materials.
679,991. ARNOPLAST, LTD.: Tray assembly for use in proving dough.
680,141. AUTOPACK, LTD., LEE, G. A., SMITH, A. R., and HOPKINS, C. J.: Machine for wrapping small quantities of salt or other powdered or granular material.
680,210. PAD-Y-WAX CO., INC.: Packaging machines.
680,264. NICKSON, H. W.: Expendable cartons or like containers for beverages and other liquids.
680,450. IMPERIAL CHEMICAL INDUSTRIES, LTD., and HEPWORTH, W.: Seaming together of polythene film.

Abstract of a Recent Specification

The Purification of Sugar Liquors

This invention, which relates to a process for clarifying and purifying sugar liquors, such as sugar cane or other sugar juices, has, as its main object, the provision of a sulphitation process which gives a clarification comparable to that obtainable by known carbonation processes at a cost comparable to that of known sulphitation processes.

Such a process is, in its broadest aspect, characterised in that the sugar liquor is treated with lime and sulphur dioxide in successive and distinctly separate stages; the sulphur dioxide treatment is applied to a liquor which has been clarified or materially clarified after the preceding "liming" which may be carried out in one or in several stages.

The liming is preferably carried out at a temperature of between 50°C. and 70°C., that is to say, so as to obtain the maximum clarification that is obtainable with "liming" while, at the same time, minimising or avoiding decomposition or partial hydrolysis of reducing sugars with lime which would result in an increase of undesirable discoloration of the juice.

If the acidity of the new raw juice is abnormally high, such abnormal acidity will be corrected to its normal value, before heating, by adding a suitable quantity of an alkaline material, such as lime or carbonate of soda.

In applying the process of the invention to the purification of any particular juice, the first step consists in determining the maximum precipitation point or most effective liming *p*H value of such juice. This is done by incremental liming on aliquot samples of the hot raw "mixed juice."

675,537. *Joseph Octave Duchenne.*

Trade Marks

BIBBEX.—704,972. Edible oils and edible fats. **J. Bibby and Sons, Limited,** 21, King Edward Street, Liverpool, 3; Manufacturers.
MELPLASH.—705,454. Poultry (other than live poultry). **Jack Dunfee,** 28, Brook Street, London, W.1; Poultry Farmer.
CHAM.—705,460. Canned meats for human use. **Molcarn, Limited,** 65, London Wall, London, E.C.2; Merchants.
SNOW-CRYSTAL.—705,525. Refrigerators, refrigerating chambers, and refrigerating installations. **The Airscrew Company** and **Jicwood, Limited,** Blackboy Works, Weybridge, Surrey; Manufacturers.
KENMIX.—705,697. Mixing machines for treating foodstuffs. **Kenwood Electrics, Limited,** Kenwood Works, Ripley Street, Old Woking, Surrey; Manufacturers.
SKELS.—705,728. Non-medicated confectionery. **Smith Kendon, Limited,** 132, Borough High Street, London, S.E.1; Manufacturers.
TEASOL.—706,370. Tablets made principally of tea for making a beverage. **George Wright Taylor,** 60, Leeds Road, Bradford, Yorkshire; Manufacturer and Merchant.
GAYLORD.—706,407. Meats, fish, game, poultry, and vegetables, all being cooked or frozen foodstuffs; and shredded suet and pickles. **Philip Carl Unger,** 134A, Roe Lane, Southport, Lancashire; Food Canner.
BREVIT.—706,467. Flour, bread, cakes, and biscuits (other than biscuits for animals). **Merchants and Producers, Limited,** VitBe Flour Mills, Crayford, Kent; Millers and Manufacturers.
FRULOVA.—707,159. Bread. **Lifeguard Products, Limited,** 7 to 11, Old Bailey, London, E.C.4; Manufacturers and Merchants.
TOPSY.—707,226. Table jellies. **Frozen Confections, Limited,** The Model Factory, Warwick Road, Hampton Wick, Kingston-on-Thames, Surrey; Manufacturers and Merchants.
POPJACK.—707,423. Cereal preparations for food for human consumption. **Lifeguard Products, Limited,** 7 to 11, Old Bailey, London, E.C.4; Manufacturers and Merchants.
ONESTA.—707,442. Edible oils and edible fats. **Thomas Hedley and Company, Limited,** Phoenix Buildings, Collingwood Street, Newcastle-on-Tyne; Manufacturers.
TEAL.—708,072. Dates. **Selim Homsy Trading Company, Limited,** 32, St. Mary Axe, London, E.C.3; Merchants.

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New Companies

Teemac, Limited. (508910.) Suffolk House, Laurence Pountney Hill, Cannon Street, London, E.C.4. To carry on business of manufacturers of and dealers in food products, foodstuffs, etc. Nom. cap.: £1,000 in £1 shares. Dirs.: A. Maislish, 4, Kidderpore Gardens, London, N.W.3; R. H. Clements, 39, Tudor Avenue, Gidea Park, Essex.

Norman Smorgon and Sons (England), Limited. (509049.) To import and export canned, dried, frozen, and fresh fruit and food of all kinds, etc. Nom. cap.: £100 in £1 shares. Dirs.: to be appointed by subs. Subs.: J. H. Thomlinson (solr.), 70-71, Gracechurch Street, London, E.C.3; J. W. Sharman (chartered secy.), 23, Blomfield Street, London, E.C.2.

Surety Products, Limited. (509088.) The Green, Ruddington, Notts. To take over business of potato crisp manufacturers and dealers and confectioners carried on at Ruddington, Nottingham, as "The Surety Products." Nom. cap.: £5,000 in £1 shares. Dirs.: H. Heaselden, Ebenezer House, Cropwell Bishop, Notts., C. Davis, 6, Ouchan Drive, Carlton, Notts., H. S. Heaselden, Edith M. Heaselden, Mrs. J. A. Heaselden, and Marguerite G. Davis.

Beano, Limited. (509097.) To carry on business of manufacturers of confectionery, sweets, chocolates, etc. Nom. cap.: £100 in £1 shares. Dir.: A. L. Wilkinson (clk.), 6, Springfield Road, Tottenham, London, N.15. Sub.: S. Slavin (clk.), 35, Westpole Avenue, Cockfosters, Herts.

Goodall, Young and Company, Limited. (509221.) 46, Curzon Street, London, W.1. To carry on business of general merchants, manufacturers of and dealers in produce, foodstuffs, chemical products, etc. Nom. cap.: £1,000 in £1 shares. Dir.: P. D. Goodall, 271, Worting Road, Basingstoke.

Mayfair Biscuit Company, Limited. (510412.) 11, Old Jewry, London, E.C.2. Nom. cap.: £100 in 5s. shares. Dirs.: not named. Subs.: C. J. Pollard and J. B. Gowman (clerks), 11, Old Jewry, London, E.C.2.

Frozen Confections (Provincial), Limited. (510432.) 26/8, Hallam Street, Portland Place, London, W.1. To carry on business of manufacturers of and dealers in iced and frozen confections, frozen foods, ice cream, etc. Nom. cap.: £100 in £1 shares. Dirs.: Patricia M. Garratt and T. T. C. Garratt, Bibury, Broad Highway, Cobham, Surrey.

F. G. Billing and Son, Limited. (510502.) Worth Mill, Worth, nr. Sandwich. To carry on business of mill proprietors and millers, flour manufacturers and dealers, corn factors, etc. Nom. cap.: £5,000 in £1 shares. Dirs.: P. Billing, Mrs. L. G. Billing and G. V. Borton, all of Glenavy, Worth, Sandwich, and A. G. Billing, Mill House, Worth, Sandwich.

J. Jangaard, Limited. (510508.) St. Magnus House, 25, Monument Street, London, E.C.3. To carry on business of manufacturers of and dealers in fish and fish products, etc. Nom. cap.: £500 in £1 shares. Dirs.: J. A. Jangaard, 71, Rochester Drive, Southend-on-Sea, and H. Taylor, 13, The Glade, Woodford Wells, Essex.

From Jordan and Sons, Limited, Company Registration Agents, 116, Chancery Lane, London, W.C.2.